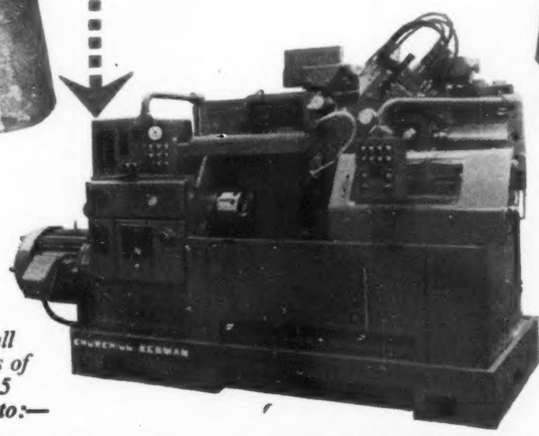
MACHINERY

SEPTEMBER 24, 1958 ONE SHILLING & THREEPENCE

2 minutes and 1 second

This nickel chrome molybdinum steel gearbox mainshaft, nearly 16″ long was produced from a forging in two minutes and one second on a Churchill-Redman P.5 Lathe.
In this time 3½ lbs. of metal were removed.
This is the usual high speed of operation obtainable on a **Churchill-Redman. P.5 Multi-tool and Profiling Machine.** Ample power and the speed of feed make substantial new machining economies possible.



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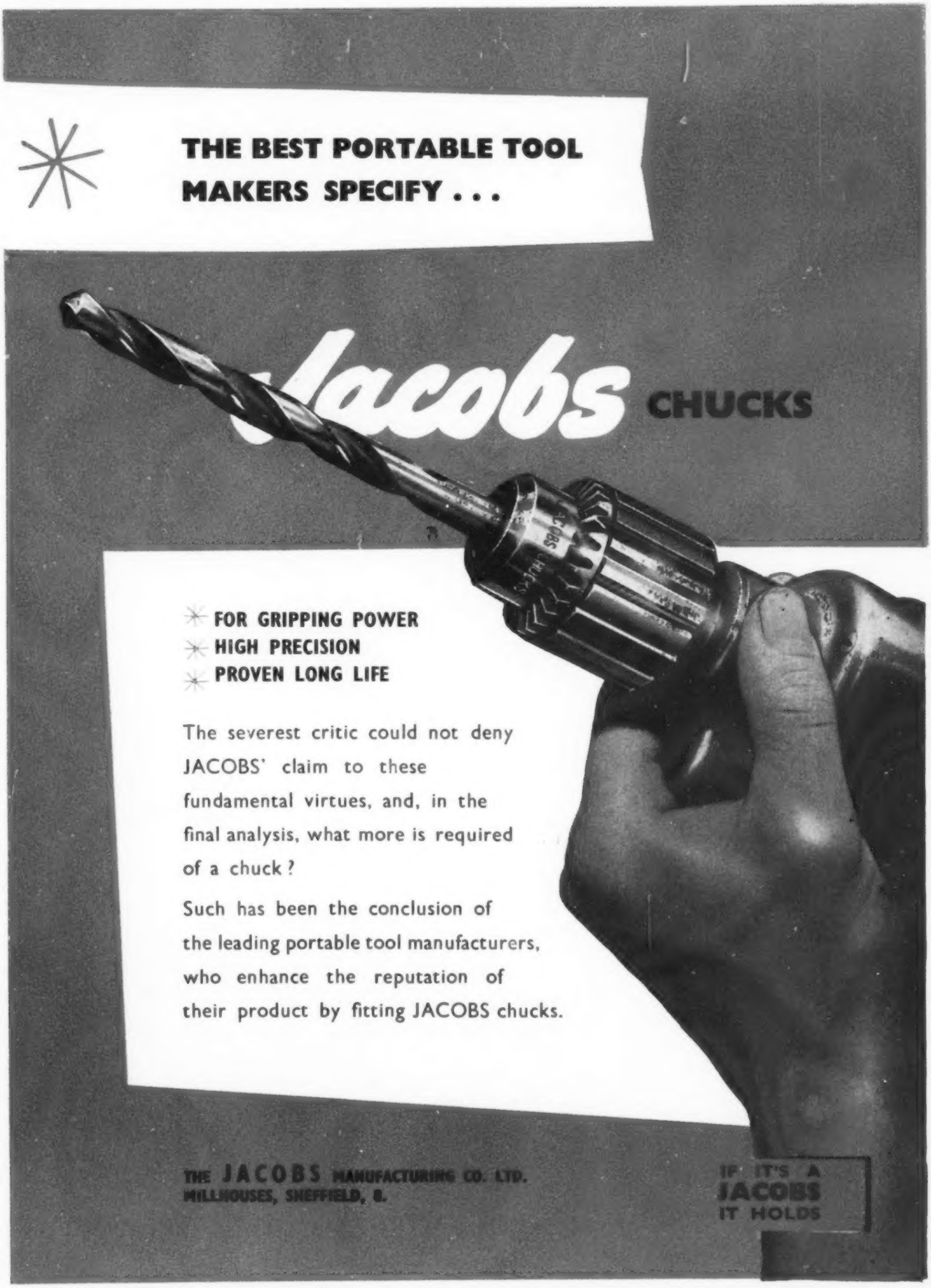
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Such has been the conclusion of the leading portable tool manufacturers, who enhance the reputation of their product by fitting JACOBS chucks.
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HYDRAULICALLY OPERATED
RAPID POWER ELEVATION OF KNEE
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MAX. CROSS TRAVERSE 9"
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26" MAX. TABLE STROKE
32"
10½" UNDER WHEEL
This latest development model SG3H is "the" Machine for rapid Surfacing in the Toolroom or Production Shop.
Detachable Spindles are available for deep and intricate work.
Hydraulic Control allows the operator to "inch" the Table along or stop instantaneously in any position at will.
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SG-1
Machinery
Sept. 24, 1958

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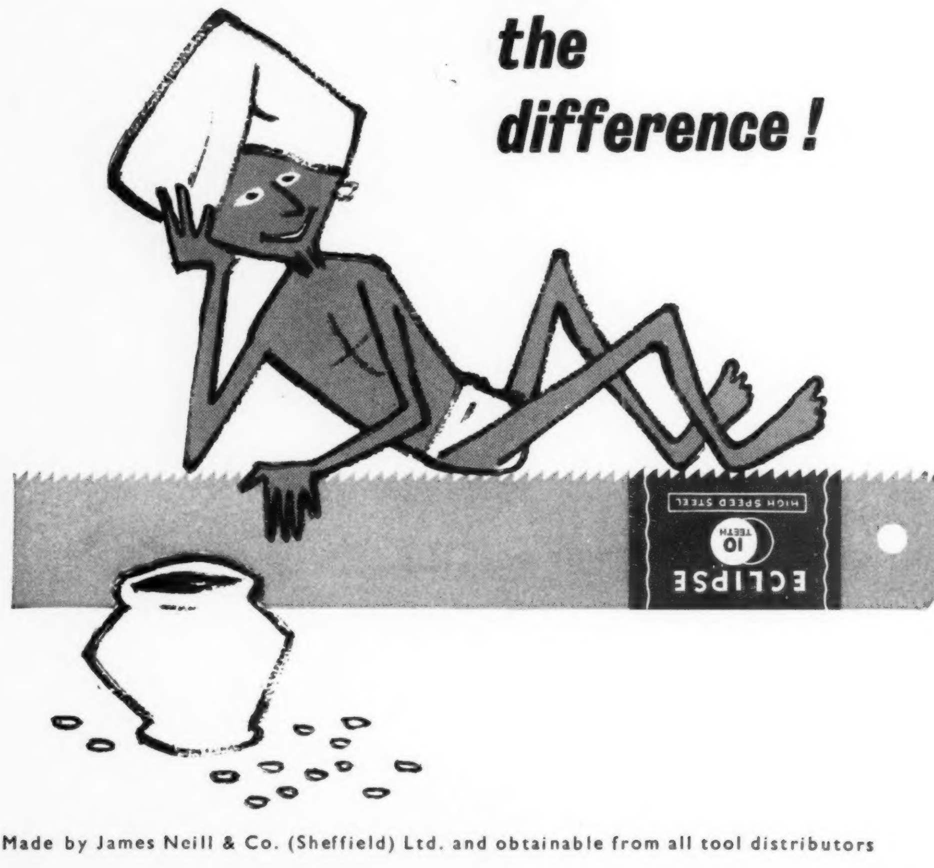


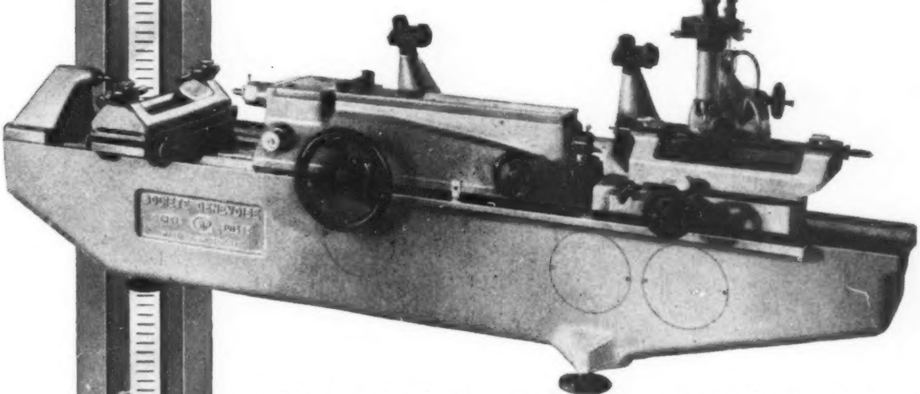
Made by James Neill & Co. (Sheffield) Ltd. and obtainable from all tool distributors

UH 28

The STANDARD Scale

The Standard Scale is graduated on the same machine and with the same great precision as are the fundamental length prototypes supplied by SIP to the National Physical Laboratory (Teddington): the International Office of Weights and Measures (Sèvres) and the National Bureau of Standards (Washington). It is the basis of all measuring instruments manufactured by Société Genevoise d'Instruments de Physique and provides absolute measurements.

Type MUL-1000 Linear capacity 1 metre



The Universal Measuring Machine

robust . . . versatile . . . easy to operate

Guaranteed measuring accuracy:

up to 4″	... ...	0·00002″ max. error
up to 20″	... ...	0·00004″ ,, ,,
up to 40″	... ...	0·00006″ ,, ,,

This machine measures lengths up to 40″; inspects the elements of threads up to 5″ in diameter; checks tapers and solids of revolution. It is able to measure in rectangular co-ordinates. It possesses micrometer and goniometric microscopes; readings are easily and speedily taken.

The Universal Measuring Machine is used to measure flat and spherical-ended standards, cylindrical and screw gauges, ring and snap gauges, contour gauges and many standard workpieces. Accessories enable the Machine to be adapted to other requirements.

The MUL-1000 is one of several Measuring Machines in the manufacturing programme of Société Genevoise d'Instruments de Physique which also includes:

- MUL-3000 and MUL-4000 Universal Measuring Machines of 3 and 4 metre linear capacity.
- MUL-250 Shop Gauge Measuring Machine.
- MU-214B Three Co-ordinate Universal Measuring Machine.

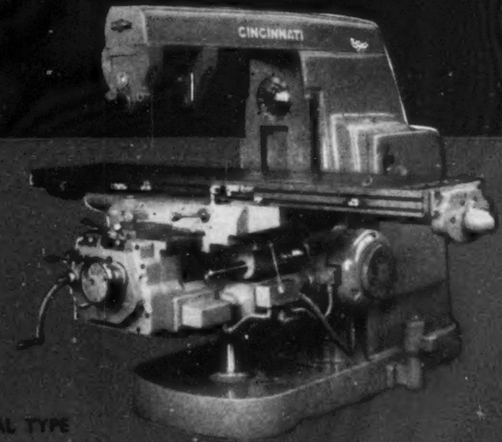
Detailed information about the scope of these unique machines is available free on request from Société Genevoise Ltd., Newport Pagnell, Bucks.

Telephone: Newport Pagnell 460/1/2.

Telegrams: SIP Newport Pagnell.

Measuring Machines by SIP

the Measure of Measures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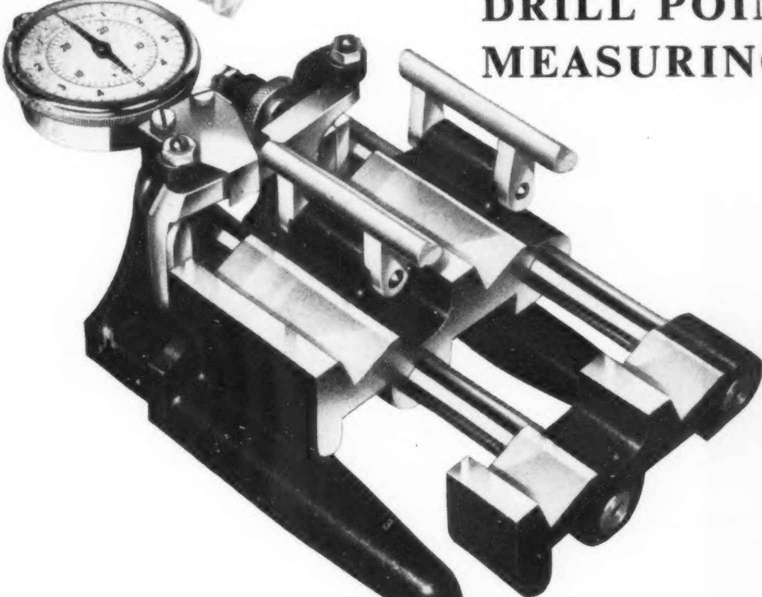
The Comparator provides a quick and simple means of checking twist drill points for centrality and correctness of angle by comparing the projected image of the drill point against a graticule. Three models available (a) Range .013″ to 3/64″ (b) 3/64″ to 1/8″ (c) 1/16″ to 1/4″.

DRILL POINT MEASURING INSTRUMENT



An Instrument for checking the larger range of drill. Two separate vee-ways are employed to align the drill, with anvils movable under the action of the drill point, and errors of angle or centrality are indicated on a common dial gauge. Setting piece supplied with each instrument. Two models available (a) Range 1/4″ to 3/4″ (b) 3/4″ to 2.1/2″.

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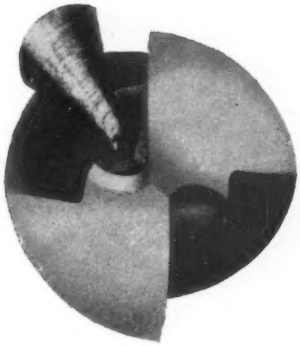

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Under closely controlled tests at one of the largest Constructional Engineering Works in the country, *SPEEDICUT "CHIPBREAKER" DRILLS* 15/16" diameter, dry drilling mild steel plates, each drilled an average of 3108 holes between regrinds. This is reported as 50% more than any other type of drill tested at these Works.

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chipbreaker drill


NOBLE & LUND
'fluifeed'
MODEL AL/CC
COLD SAWING MACHINES
Designed out of forty years' experience, devoted to cold sawing problems, the Model AL/CC, with its proven "Fluifeed" hydraulic feed, ample power and "Insto" segmental saw, is setting up the highest standards of performance on bars, billets and sections.
7 STANDARD SIZES
Saw blades from 11in. to 72in. dia. for sawing work 1in. to 26in. dia. Machines can be supplied as standard or with automatic bar feed.
NEW FEATURES
New vice which can grip on both sides of the saw blade, giving burr free cuts. Patent applied for.
Chip conveyor for removing the swarf from the machine into a container.
Safety interlock so that saw cannot feed until work is gripped in vice.
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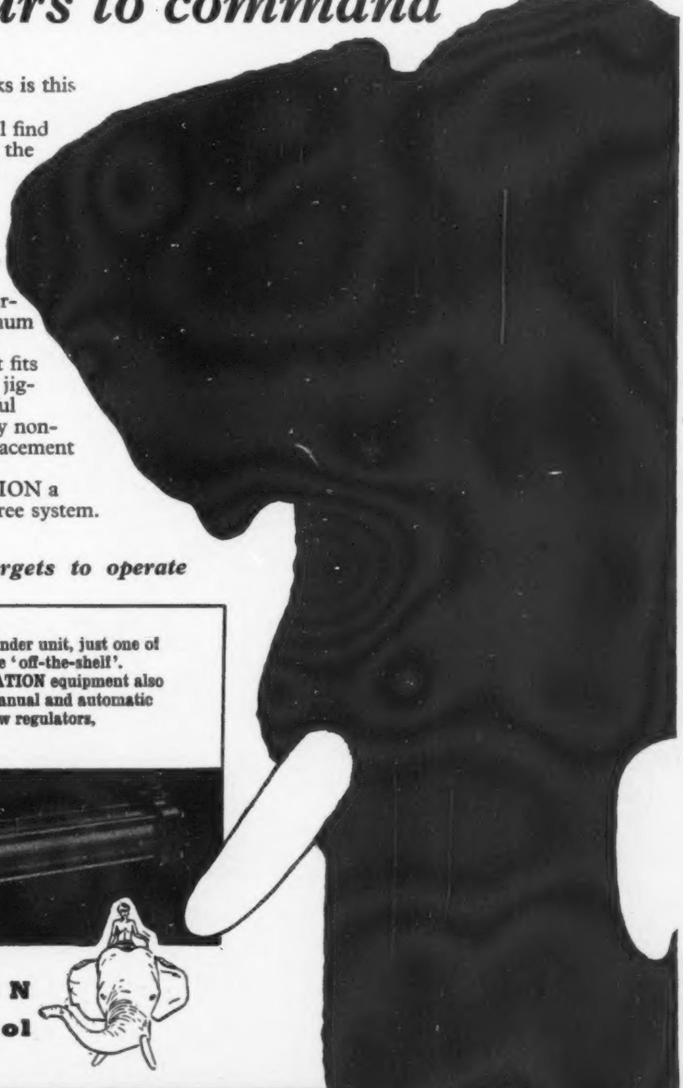

What you need in your works is this pocket-sized elephant — PNEUTOMATION! You'll find PNEUTOMATION has all the power of a pachyderm, plus compactness. You get the same tireless energy, accurately applied to the right place at the right time, under perfect control. PNEUTOMATION is tailor-made to work with the minimum of elbow room and the wide range of standard equipment fits any job from bell-ringing to jig-boring. Simple design, careful workmanship and completely non-corrodible materials cut replacement and maintenance costs, make Lang PNEUTOMATION a really long-lasting, trouble-free system.

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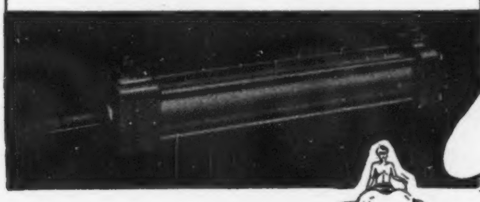
The 'Pneulang' basic cylinder unit, just one of the 264 cylinders available 'off-the-shelf'. The range of PNEUTOMATION equipment also includes many types of manual and automatic valves, lubricators, air flow regulators, pipes and fittings, etc.



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NEW FEATURES
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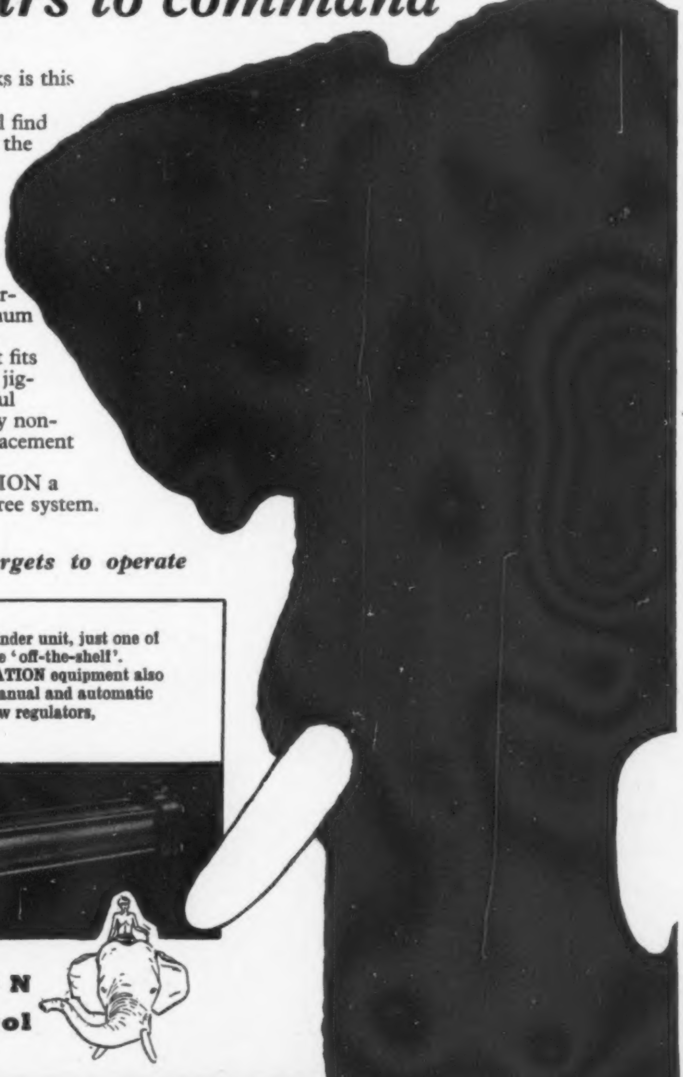

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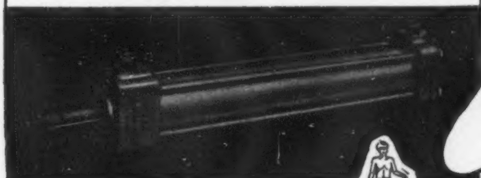

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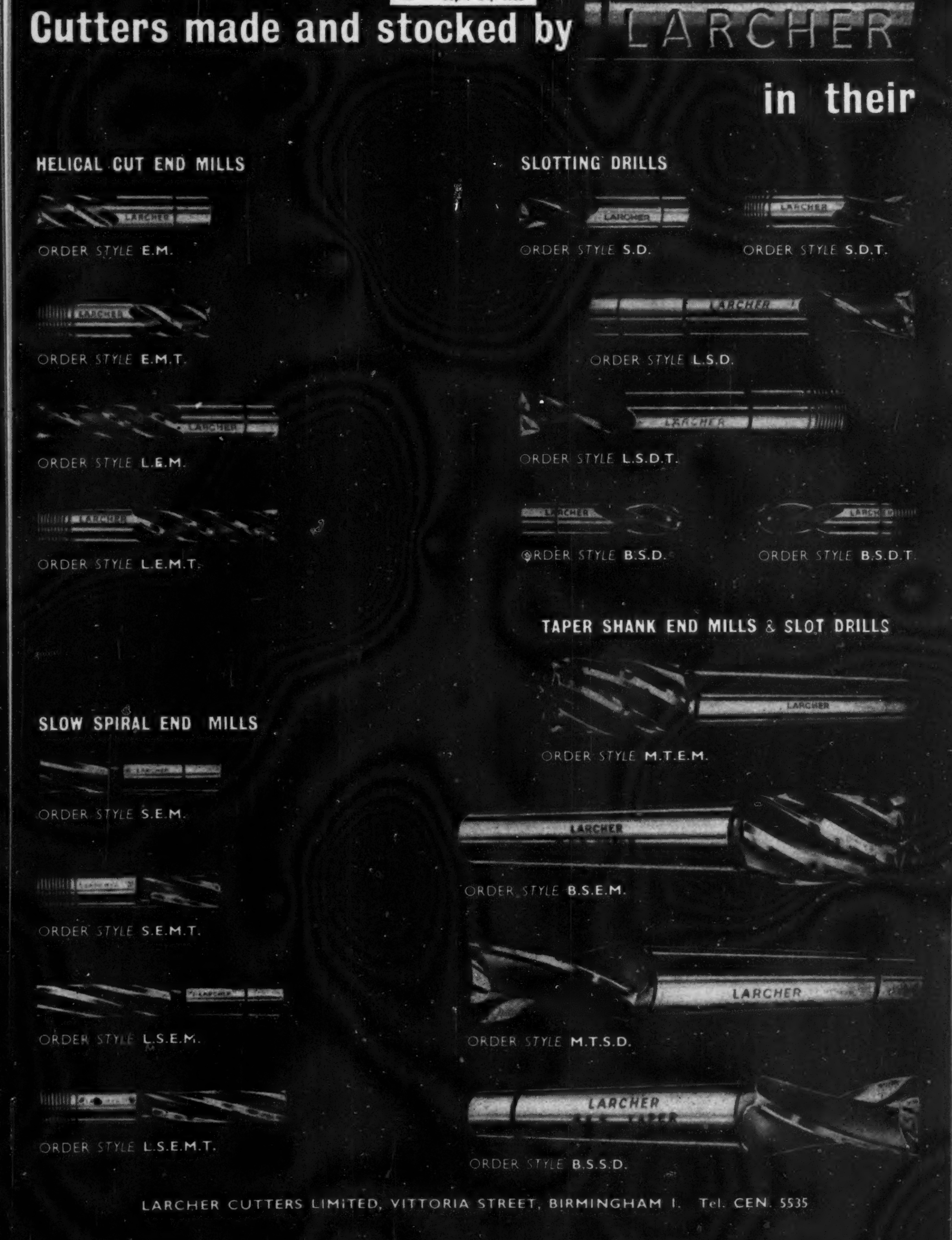
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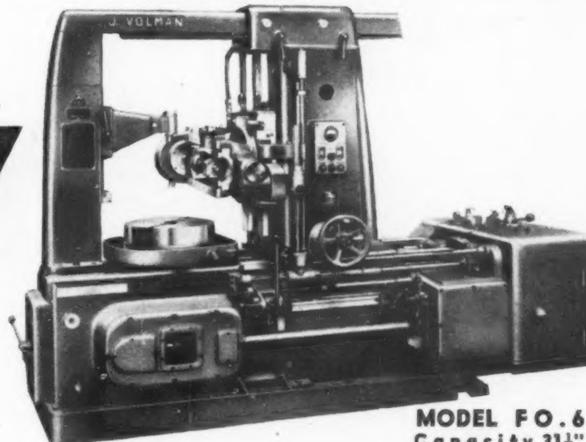

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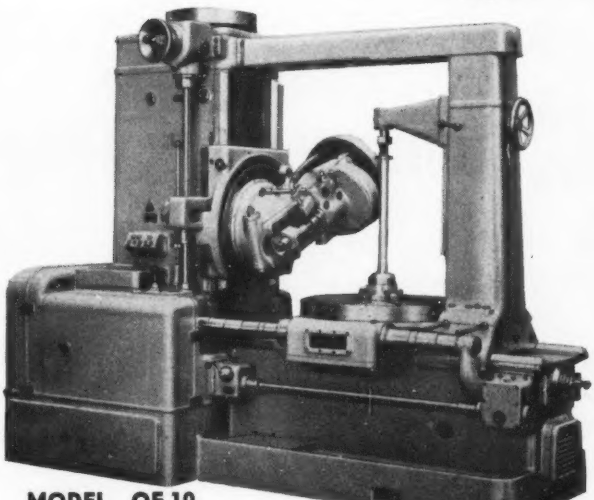

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Exclusive distributors in the United Kingdom.

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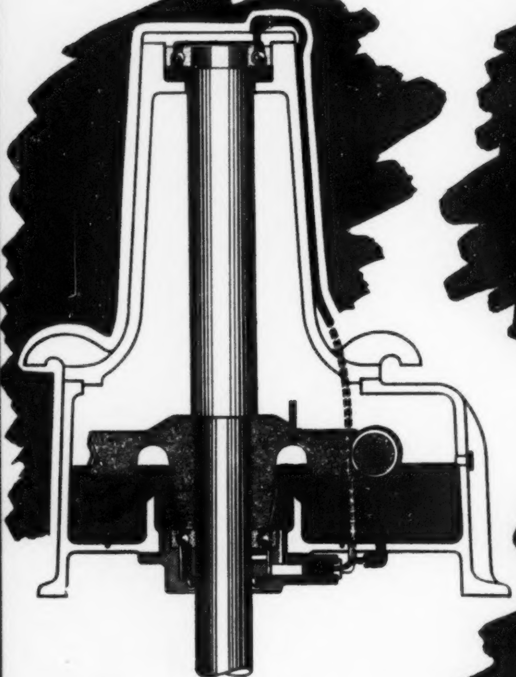

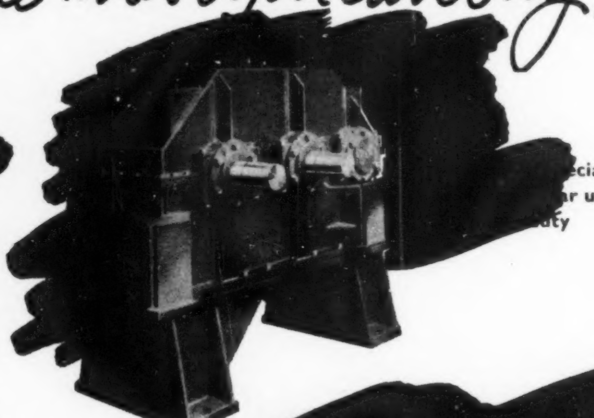

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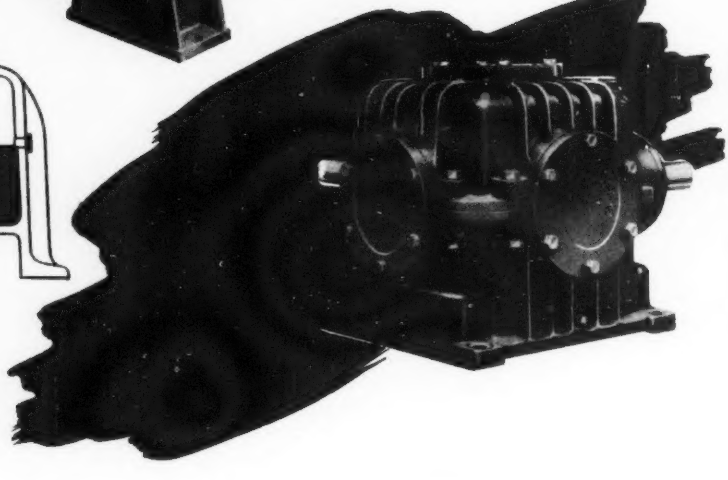

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ALFRED HERBERT LTD., COVENTRY
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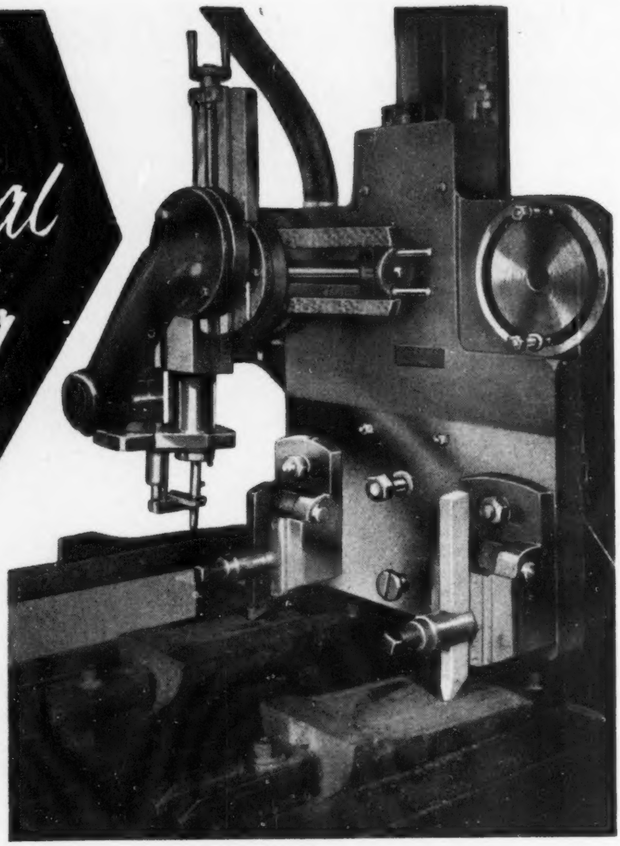
AD.447

Three-dimensional shaping



The illustration shows three-dimensional shapes being produced two at a time from a plastic template with a 1½" lift of the tool in an 18" stroke at 17 strokes per min.

Contours can be produced from templates or master patterns to angles within the limits of the tool rake on any standard shaping machine.

Suitable for Turbine Blade Production.

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UNIVERSAL HYDRAULIC DUPLICATING ATTACHMENT

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The features illustrated above are the subject matter of one or more of several patents


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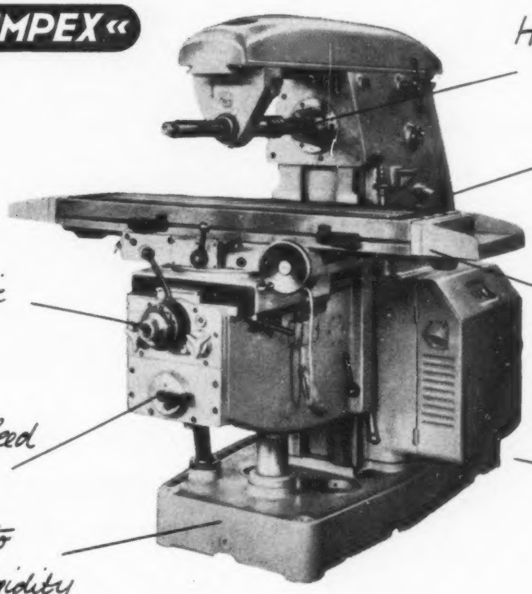
UNIVERSAL & VERTICAL MILLING MACHINE

Types UF & VF 22

»TECHNOIMPEX«



These machines incorporate a unique, foolproof single front lever which operates a range of 20 preselected dial speeds in geometrical progression from 19 to 1,500 r.p.m. The lever also controls the engagement of 18 work table feeds in all directions, rapid power traverses, start, stop and instantaneous braking. The machine is specially designed for carbide tooling; the construction of knee and column ensure the greatest strength and rigidity under the highest loads.

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POLAK diecasting machines cast aluminium, zinc, copper, magnesium and alloys of other non-ferrous metals.

Aluminium alloys can be cast up to a weight of 1·32 lbs. (1·76 lbs. in special cases), zinc alloys up to 3·35 lbs. and copper alloys up to 2·76 lbs.

Control is fully hydraulic and the semi-automatic nature of the machine enables it to be operated by semi-skilled labour.

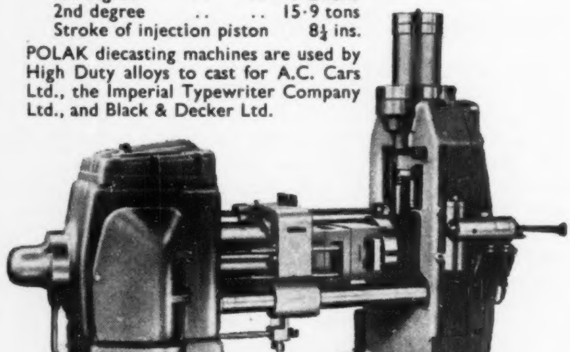
BRIEF SPECIFICATION

Average output per hour, according to casting, 80 shots to 180 shots.
Pressure of operating liquid atm., 120/1,700 p.s.i.

Closing:—
Maximum dieclosing force .. .. 85 tons
Stroke of closing piston .. .. 12⅛ ins.
Maximum opening of machine .. 29½ ins.
Minimum opening of machine .. 17¾ ins.

Pressure applied to metal:—
1st degree .. .. 11·2 tons
2nd degree .. .. 15·9 tons
Stroke of injection piston 8¼ ins.

POLAK diecasting machines are used by High Duty alloys to cast for A.C. Cars Ltd., the Imperial Typewriter Company Ltd., and Black & Decker Ltd.



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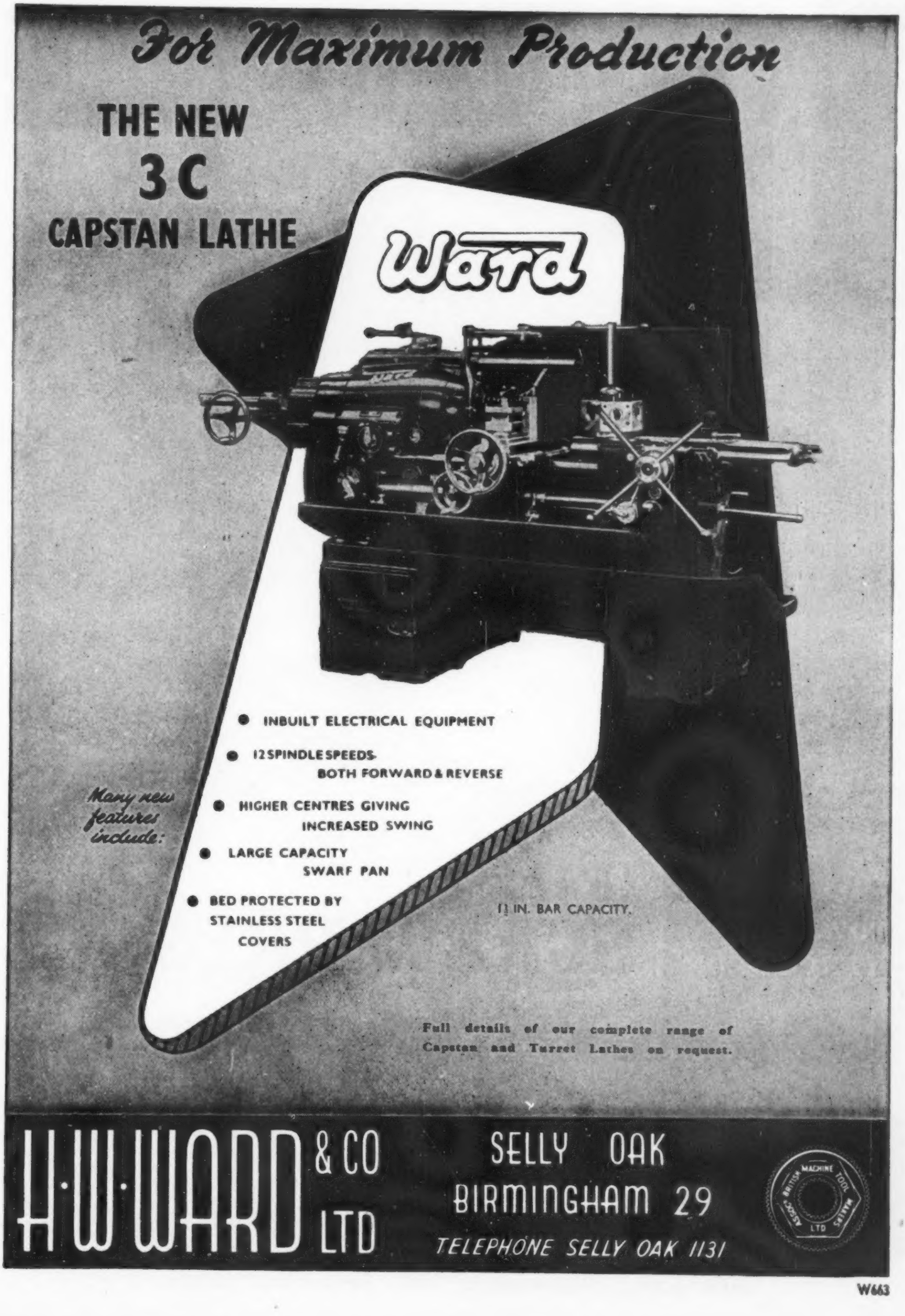

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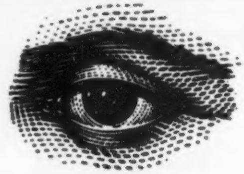
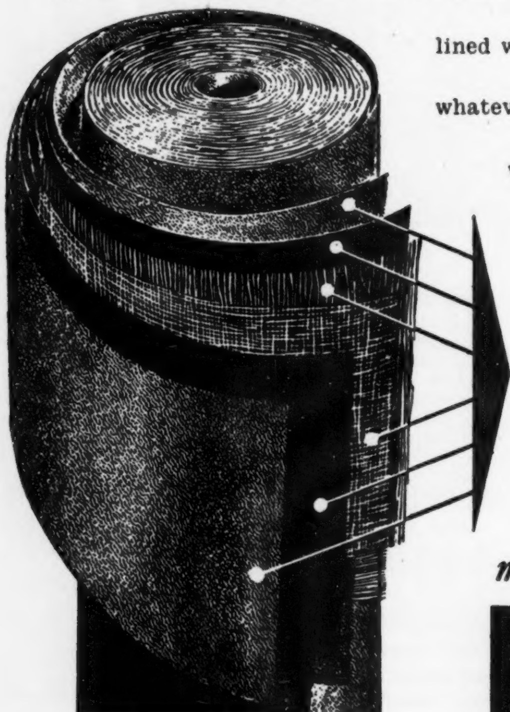
ASSOC. BRITISH MACHINE TOOL MAKERS LTD

more than meets the eye -



The eye might see FIBREEN as a sheet of ordinary packing paper—investigation would show how easily the eye is deceived. FIBREEN with its six-ply construction of cross layers of unspun sisal fibres embedded in bitumen between outer sheets of kraft paper, offers the finest possible protection against moisture and dust. Packing cases lined with FIBREEN will preserve their contents whatever the outside conditions-a very good reason why you should always insist on FIBREEN.



multi-ply protection with

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Supplied in rolls, cut sheets and purpose made case liners, with or without pressure sensitive cold seal. Samples and details from the SOLE DISTRIBUTORS

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BY SACK & KIESSELBACH

Note depth measuring device, automatically stopping machine when required depth has been reached.

SACK & KIESSELBACH have for many years been building Cold Hobbing Presses. These machines are therefore not adaptations but are designed and built for this work only. Their sound, robust basic design, high quality workmanship plus several special features found only on these machines greatly facilitates the production of sound moulds. Further details on request

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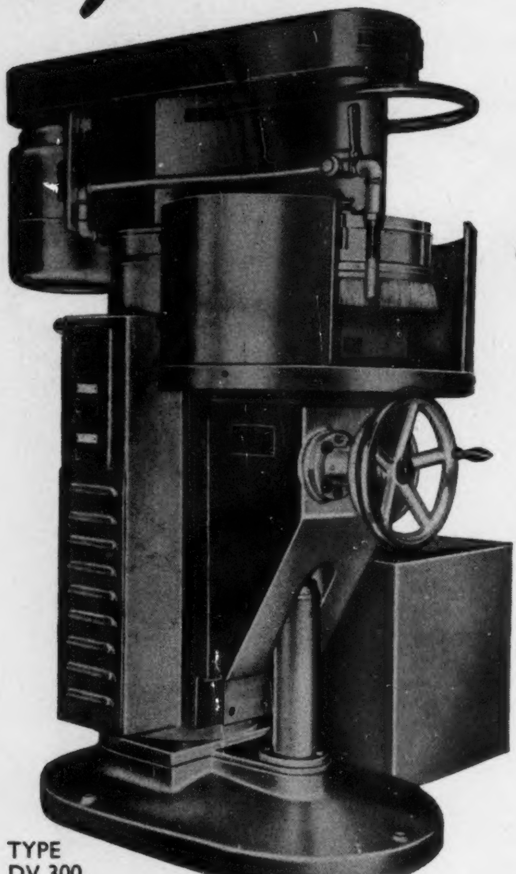
SK1

High Speed STOCK REMOVAL

DISKUS

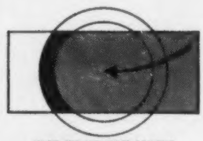
SWIVEL HEAD SURFACE GRINDER



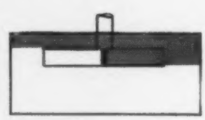
TYPE
DV 300

ENTIRE WORKPIECE SURFACE GROUND IN ONE WORKPASS

The superior stock removal capacity of the segmental grinding wheel shortens grinding time to a fraction of that taken by peripheral grinding owing to the small area of contact with the workpiece.



ONE TRAVERSE WITH DISKUS GRINDER



MANY TRAVERSES WITH PERIPHERAL GRINDING

Balanced swivel arm, mounted on heavy duty anti-friction bearings fitted to amply dimensioned column, ensures smooth and easy movement.

BRIEF SPECIFICATION—TYPE DV 300

Diameter of Segmental grinding wheel 12"
Chucking surface of work table 16" x 8"
Vertical adjustment handwheel graduated in ·0002"

Low Cost—Early Delivery

This machine is only one of the many different models of the standard and special segmental wheel grinders made by the Diskus Company.

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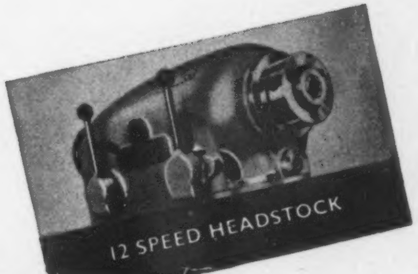
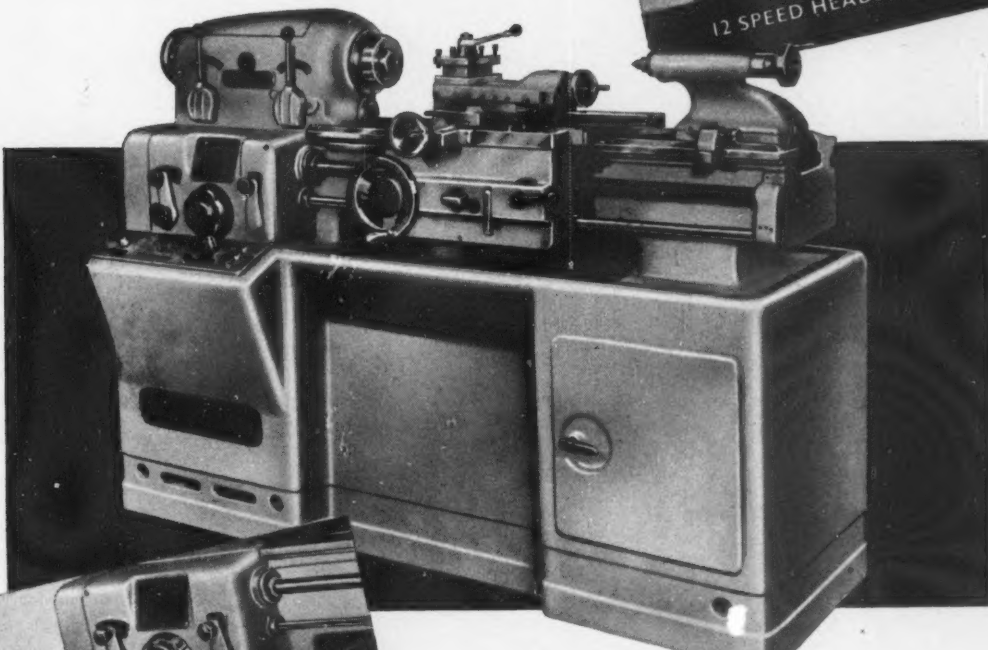
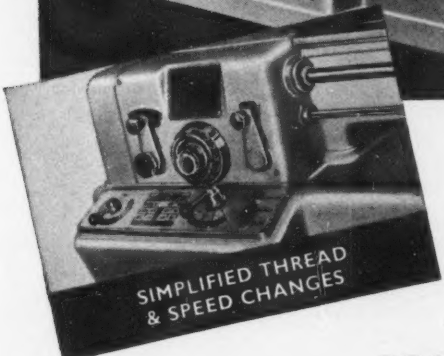
DV 300

New! Smart & Brown Precision Toolroom Lathe







MODEL 1024

The latest addition to the range of Smart & Brown toolroom lathes has been designed to ensure the highest degree of accurate operation while reducing operator's unproductive time to a minimum.

FEATURES

- 12 Spindle Speeds 30-2500 RPM
- 1" Collet Capacity
- Easy Selection of 40 Threads and Feeds 4-112 TPI
- Cam Lock Spindle Nose 4" D.I.
- Flame Hardened Bed
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- Swing Over Bed 11"
- Distance Between Centres 24"

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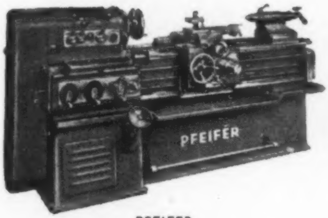
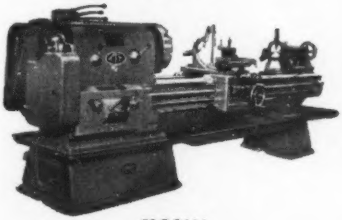


PFEIFER



TROGLIA

PFEIFER PRECISION TOOLROOM LATHE MODEL P 12
9" swing by 40" between, turning accuracy 0·00008", 14 speeds 11 to 1,000 r.p.m. swings 21¼" in gap, hollow mandrel 1 7/16", Norton Feed Box, 187 threads, Whitworth Metric and Module, Travelling Steady, driving plate, motorised four pole motor, A.C. 415/3/50. **Price, £1,275** FROM STOCK.
Extras: Taper Turning Attachment, Suds Pump, Fourway Toolpost, etc.

TROGLIA LATHE TYPE TPM 20 (FROM STOCK)
10" centre x 76" between, swings 31" in gap, Hollow Mandrel 2 1/16", 18 speeds, 20-850 r.p.m., Norton gearbox for Whitworth, Metric and Module threads, 4-jaw face plate chuck, 2 steadies, motorised suds pump, motorised A.C. 415/3/50. **Price, £1,100** Equipment inclusive.

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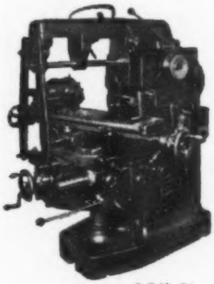

P.T.V. 51

P.T.V. UNIVERSAL MILLING MACHINE MODEL PTV 51
Table working surface 33½" x 8¼". Eight auto longitudinal feeds, 9 spindle feeds 60 to 1,200 r.p.m., including 4¼" Universal Dividing Heads, Braces, motorised Suds Pump, motorised A.C. 415/3/50. Vertical attachment extra.
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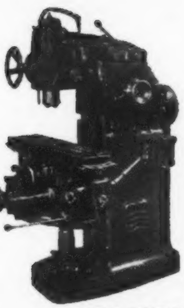

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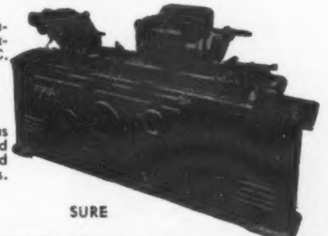

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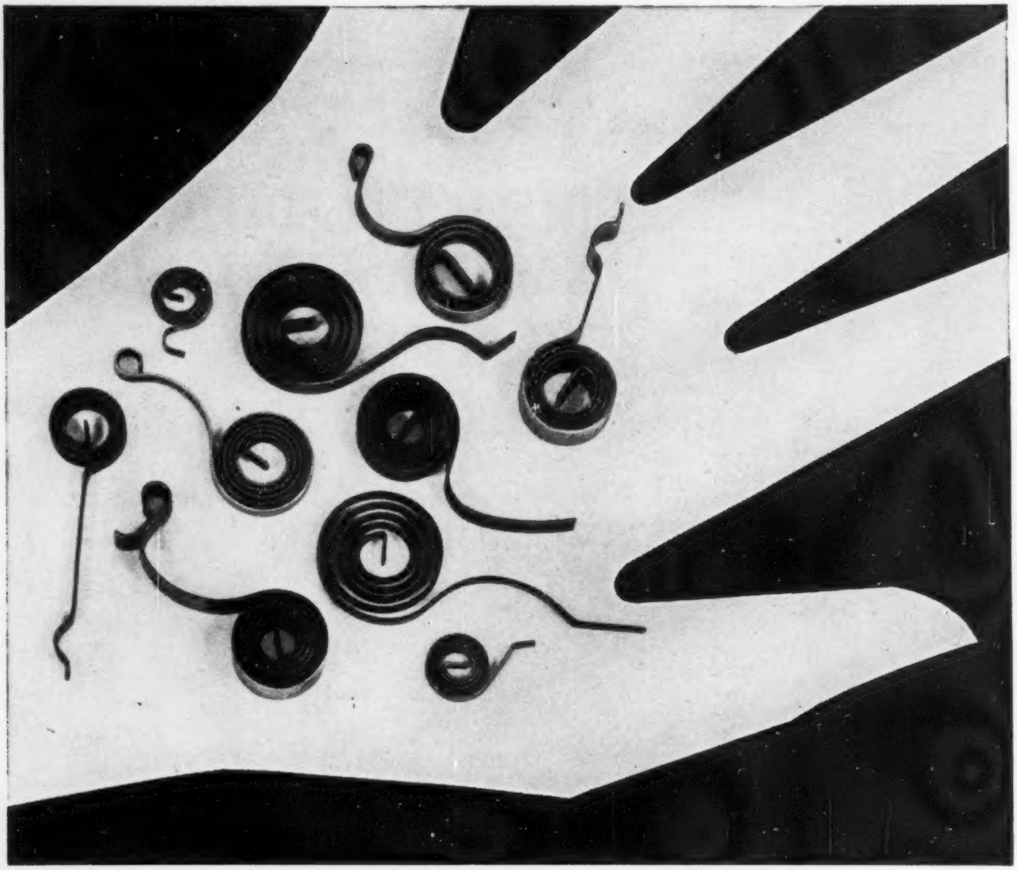

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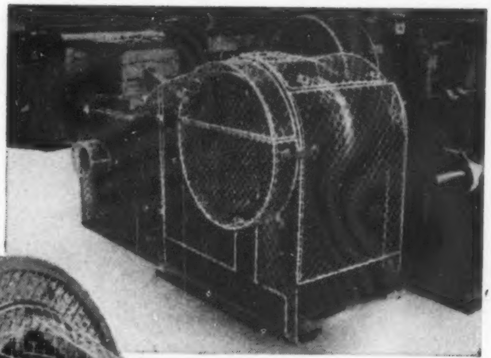
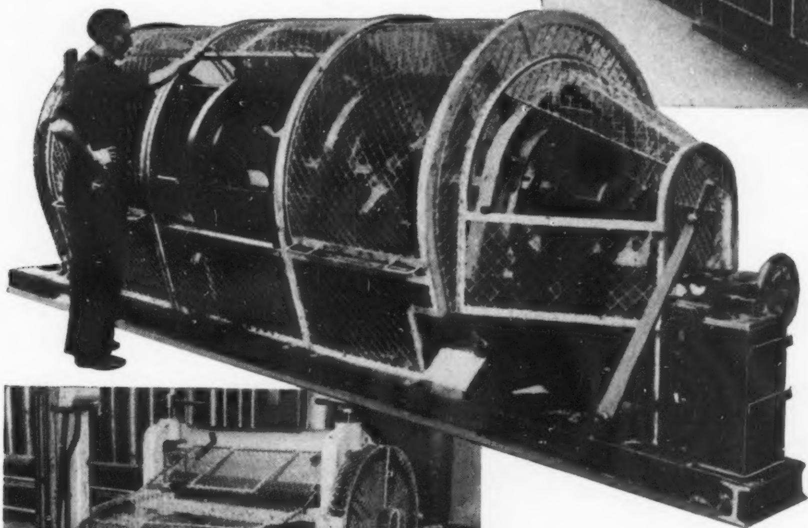




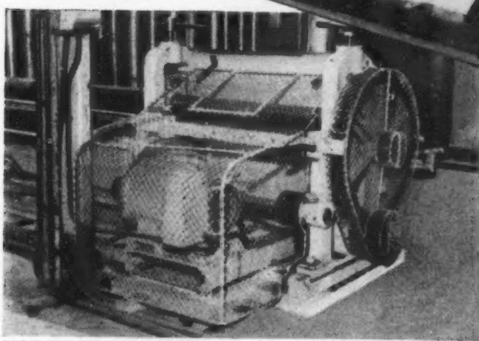
In

Wirework

or

Sheet

Metal



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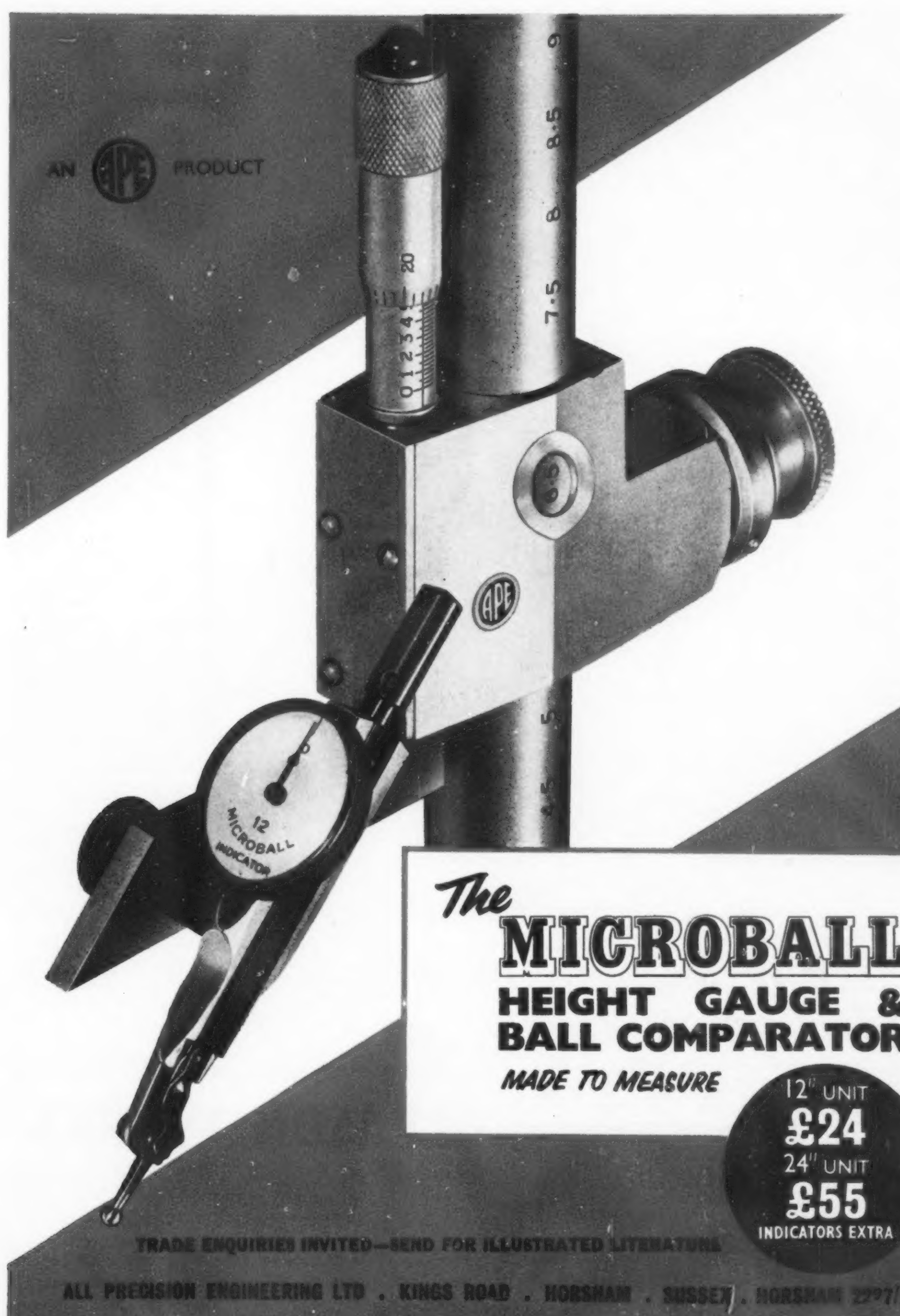
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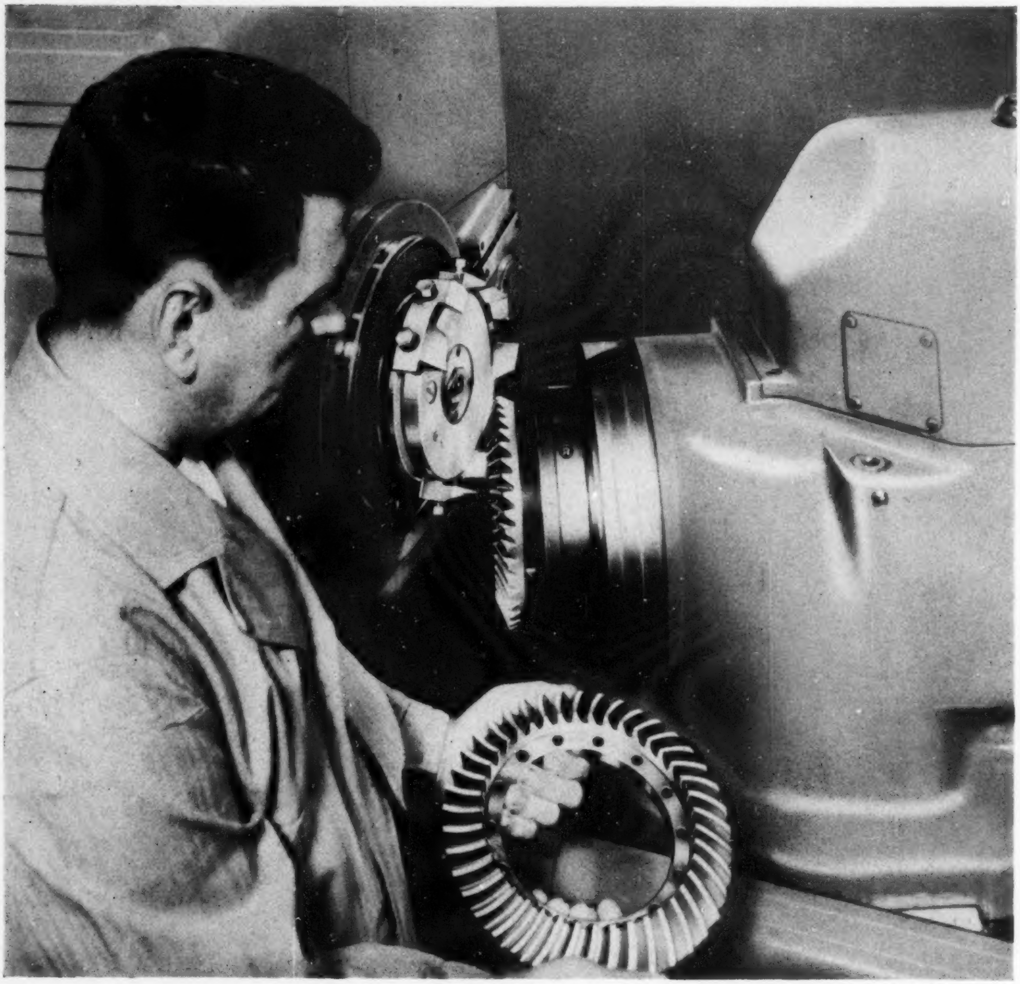
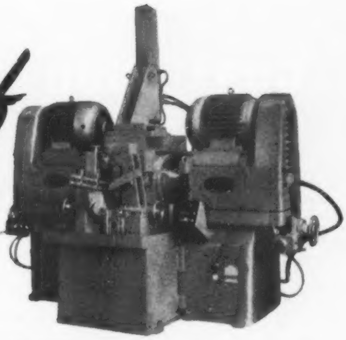


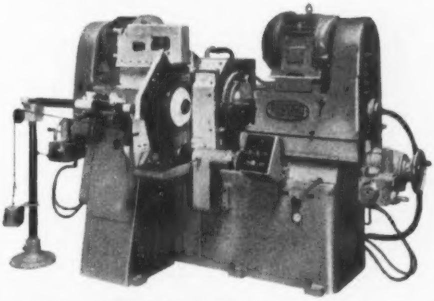
The fastest method of grinding two surfaces simultaneously!

ROWLAND

DUPLEX SURFACE GRINDERS

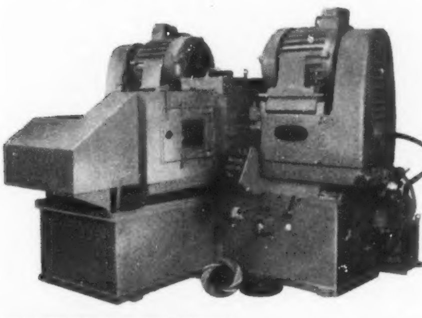


CIRCLIPS 30in. Type ADD/F

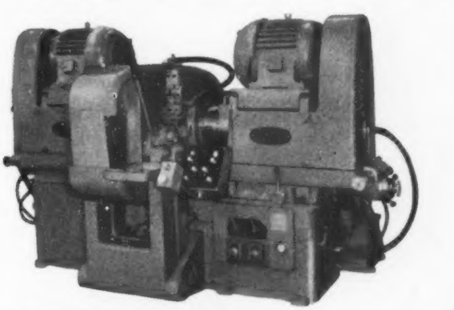


CALCULATOR PARTS 20in. Type HDD/C

* Illustrated here are but a few of the very many types of 'Duplex' surface grinding machines that we manufacture.



BRAKE DISCS 30in. Type ADD/H



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* All machines are capable of extremely impressive rates of production, coupled with high degrees of accuracy and surface finish.

Our technical representatives are ready, able and willing to co-operate with you.

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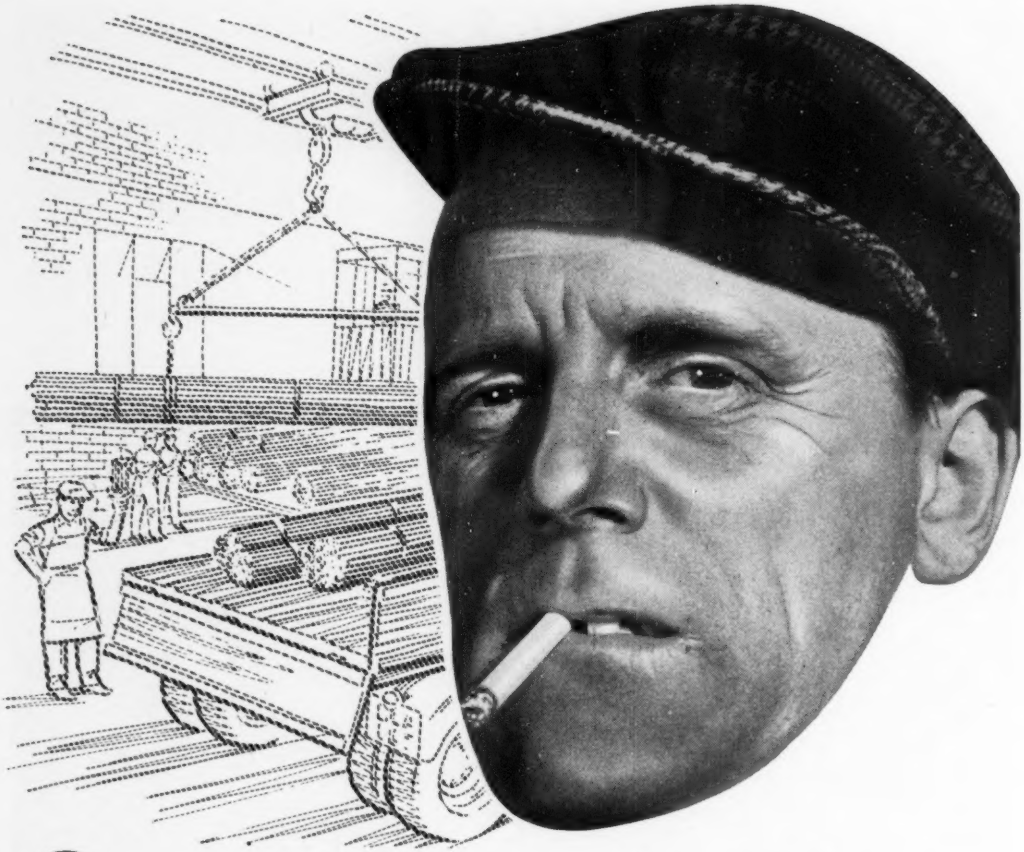
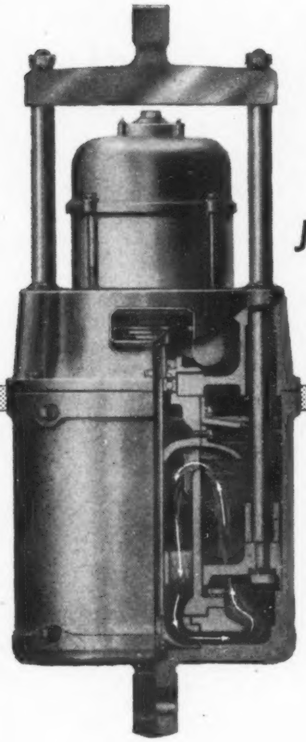


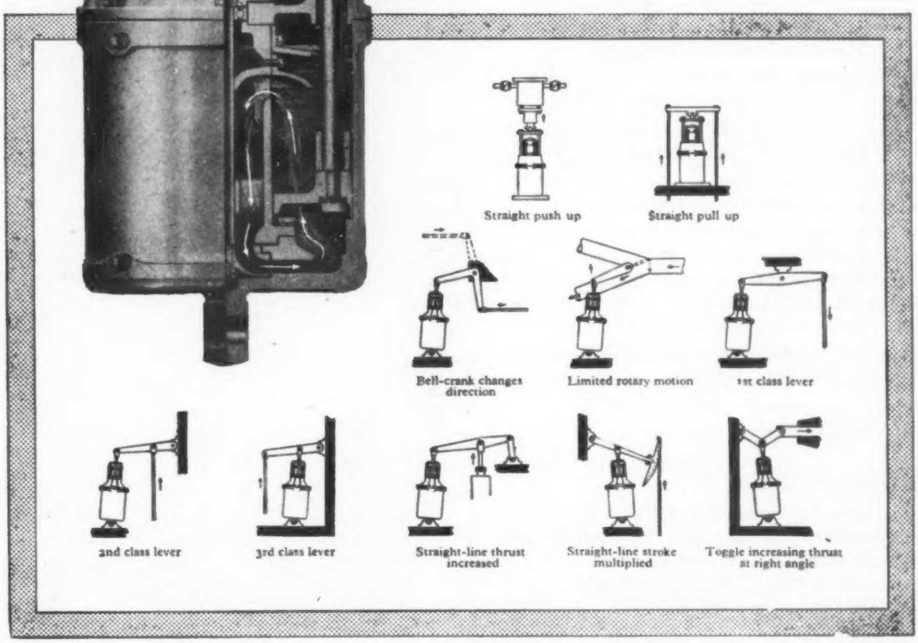
Electro - Hydraulic Thrustors



Smooth straight-line constant-pressure thrust from start to finish of stroke.
From 40-lb. thrust, 2-in. stroke to 800-lb. thrust, 12-in. stroke.

Just switch on—

the thrustor does the work



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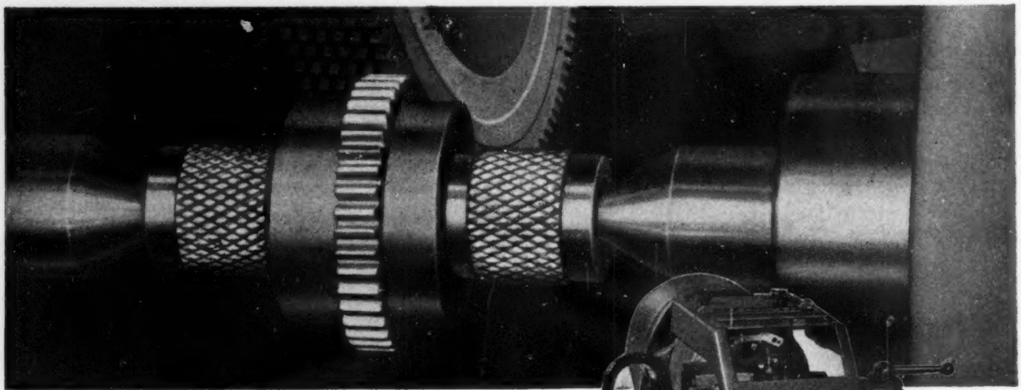

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The VS4A can shave spur and helical gears up to 4 inches in diameter and 1 inch face width, with a pitch as coarse as 16 D.P.

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The VS4A, once loaded, will rapidly and automatically perform a full cycle of operation varying from 13 to 45 seconds—depending on the material and characteristics of the component.

If you want perfection . . .
highest accuracy, best surface finish and quietest operation is achieved by gears which have been shaved. If the fine pitch gears you produce have a total composite error of more than 0.0003 inches, you should find out more about the VS4A.

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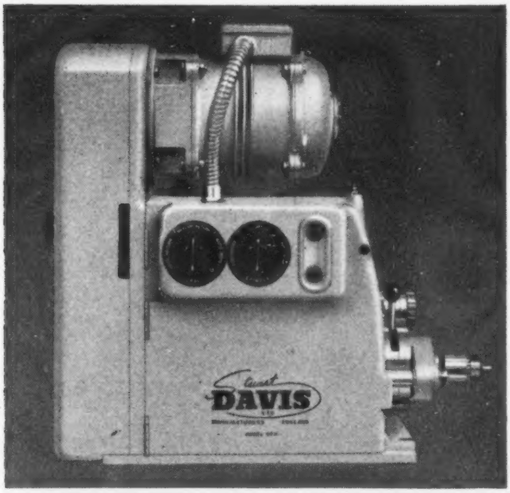
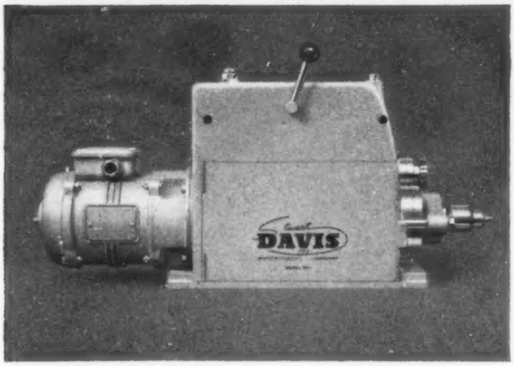
How many drilling machines do your operators attend ?





probably only one
it could be dozens with
"DRILL-MATIC"
standard drilling units.

To fulfil the demand for a low cost, compact, self-contained drilling unit we have produced the range of " Drill-Matic " standard drilling units. They are made to machine tool standards, with adequate torque and thrust capacity. The spindle bearings are capable of withstanding moderate side thrust such as is encountered in boring. The feed is air powered hydraulically controlled, infinitely variable, fast approach and return without backlash owing to the complete absence of cams or rack gears.

These Hydro-Air units can be supplied in a variety of assemblies of standard parts. They are easily interconnected together and to indexing tables either electrically or pneumatically.

Speeds: 250 to 9,000 r.p.m. No. 2 Jacobs taper.

Capacity: $\frac{5}{16}$in. in steel.

We design and manufacture special machines incorporating our drill units and RED RING pneumatic equipment.

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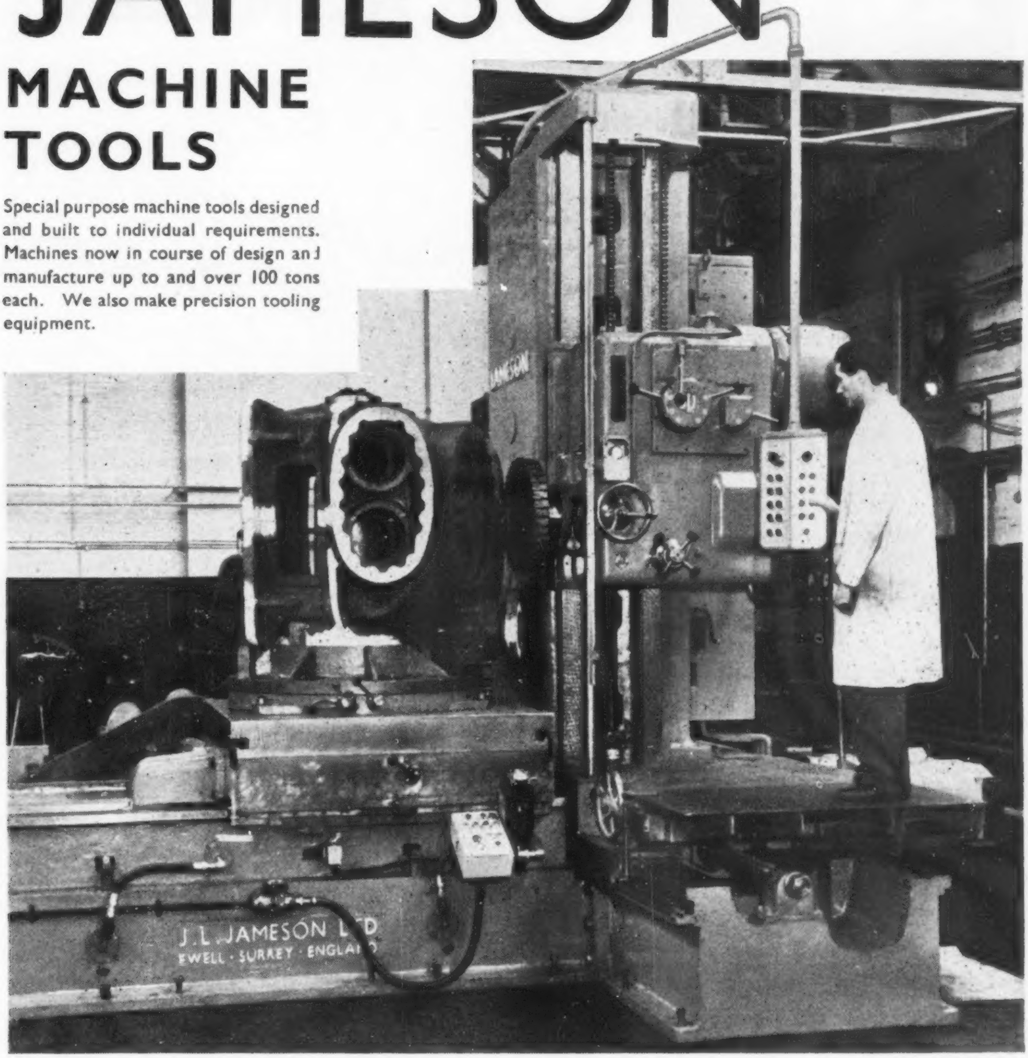

TRAVELLING COLUMN MILLING MACHINE fitted with HYDRAULIC BORING SLIDE AND 54" SQUARE, 90° INDEXING TABLE

Face milling cylinder head faces on compressor crankcase, also bored on the same set-up.

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July 30th 1958

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Air Filtration For providing completely dust-free air, to heating and ventilating and air conditioning systems.

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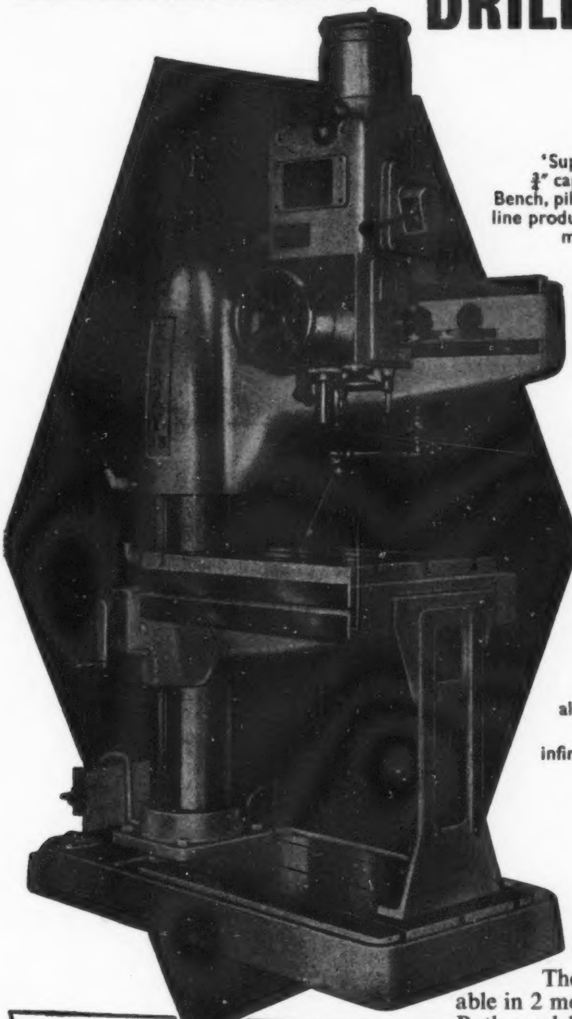
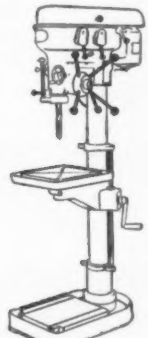
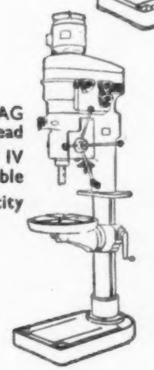


'Super 8'
¾" capacity
Bench, pillar or
line production
models

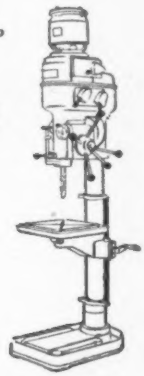
'Drillmaster'
½" capacity
Bench, pillar or
line production
models



'100'
1" capacity



'150' AG
all-geared head
'150' IV
infinitely variable
1½" capacity



'125'
1¼" capacity

The Radial Drill illustrated on the left is available in 2 models. The R3 has a swing of 36", the R4, 48". Both models have a capacity of 1½" in steel and 1¾" in cast iron. 9 spindle speeds, ranging from 90 to 1120 r.p.m. Quick hand traverse, fine hand feed and three rates of power feed. The range of Kerry drilling machines includes bench, pillar and line production models with drilling capacities from ½" to 1½".

Kerry's (Engineering) Co Ltd

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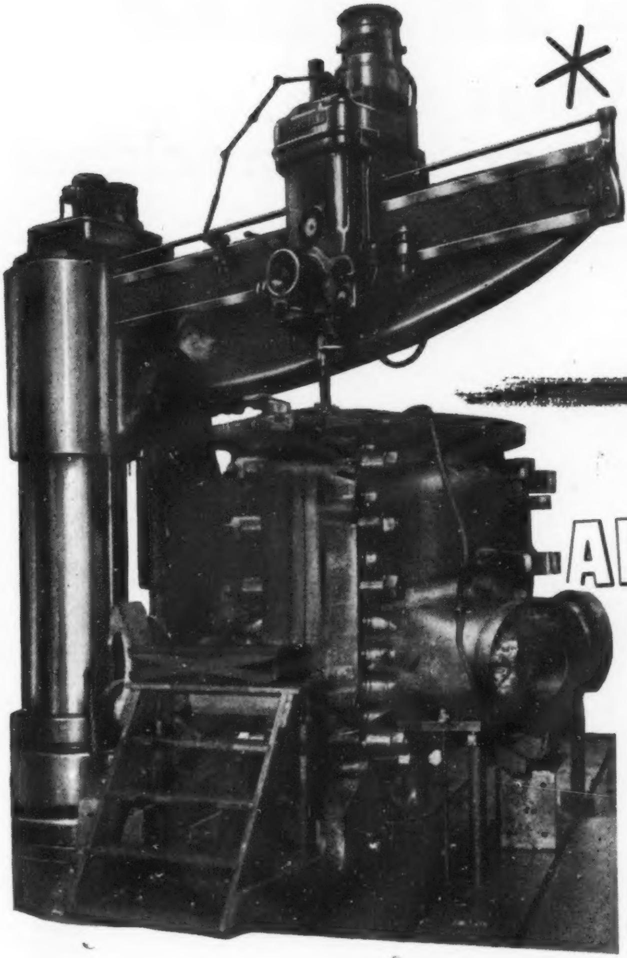

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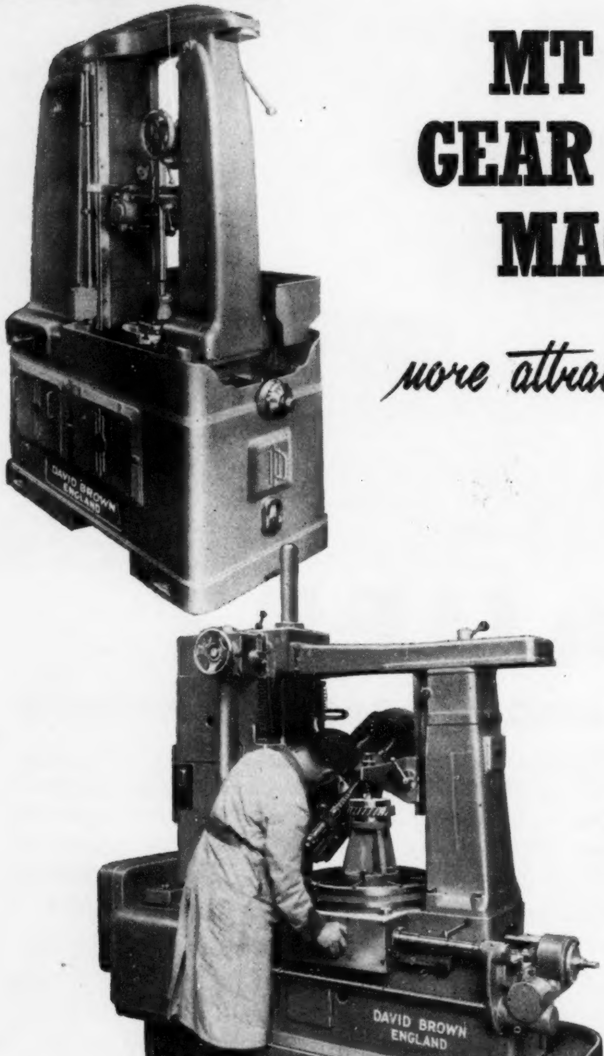

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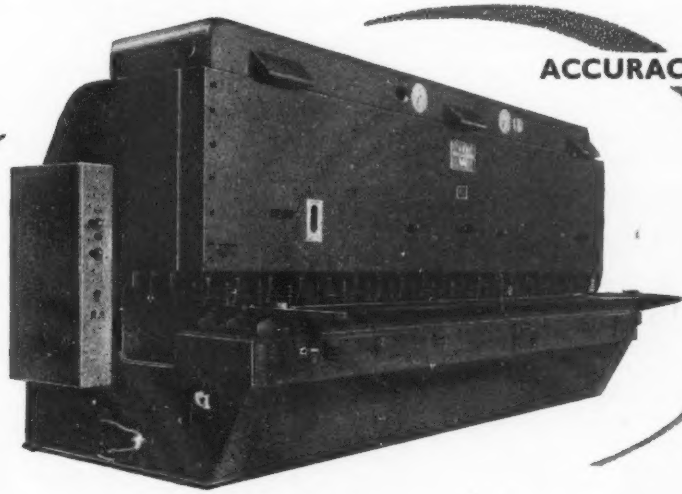

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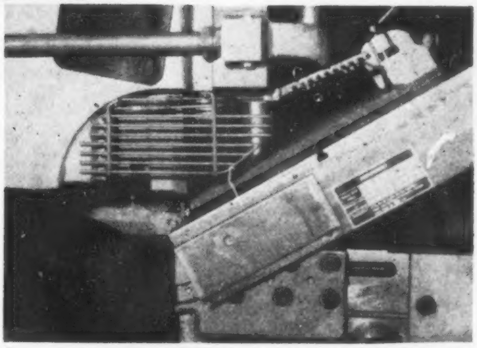

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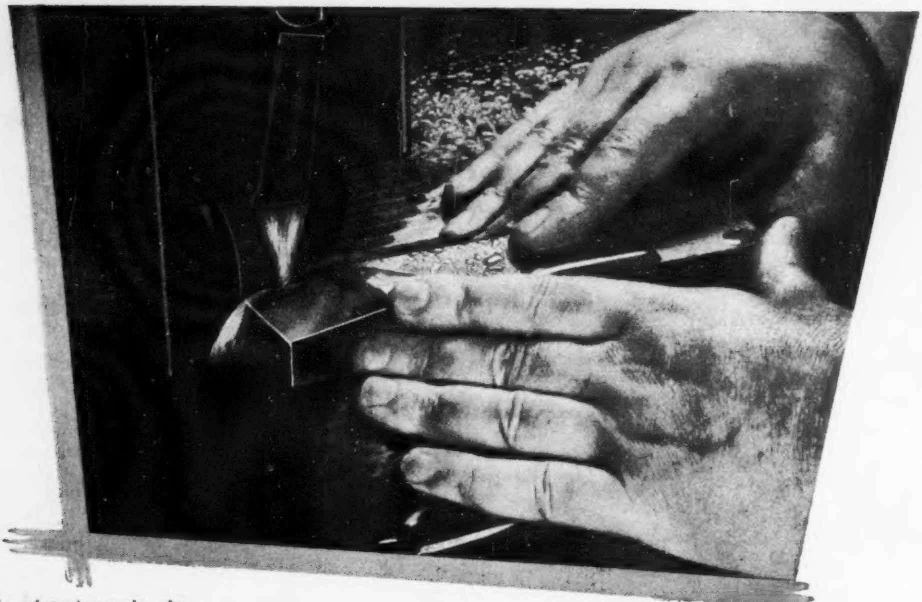
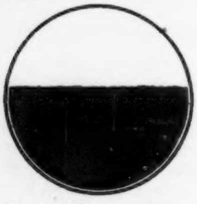


The photomicrographs show about ten thousandths of an inch of cutting edge, illustrating the difference in finish produced by grinding and lapping.

This photomicrograph shows irregularities in the cutting edge which are left after grinding on a Silicon Carbide Wheel.



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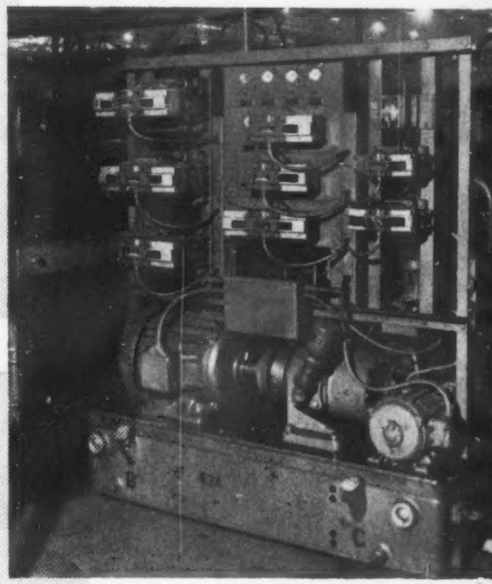
General view of the rear of the Alfing 11-Station Transfer Machines showing some of the **VICKERS-DETROIT** *Oil Hydraulics used on the cam and crankshaft boring lines for the 4 and 6 cylinder tractor blocks.*

On the right is the Alfing 11-Station Transfer Machine with covers removed to show one of the **VICKERS-DETROIT** *power units and control panel*



Ford Motor Company Limited uses
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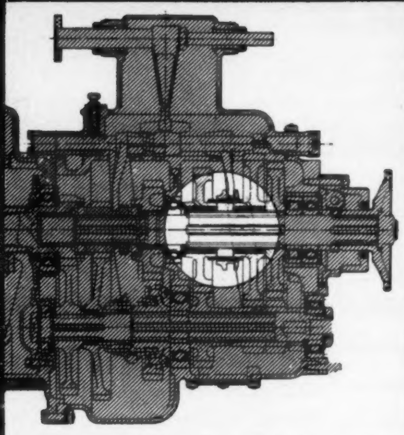

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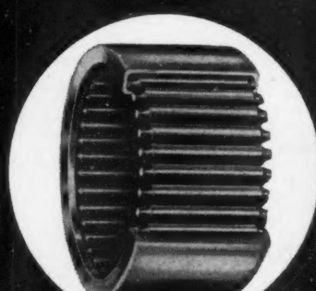

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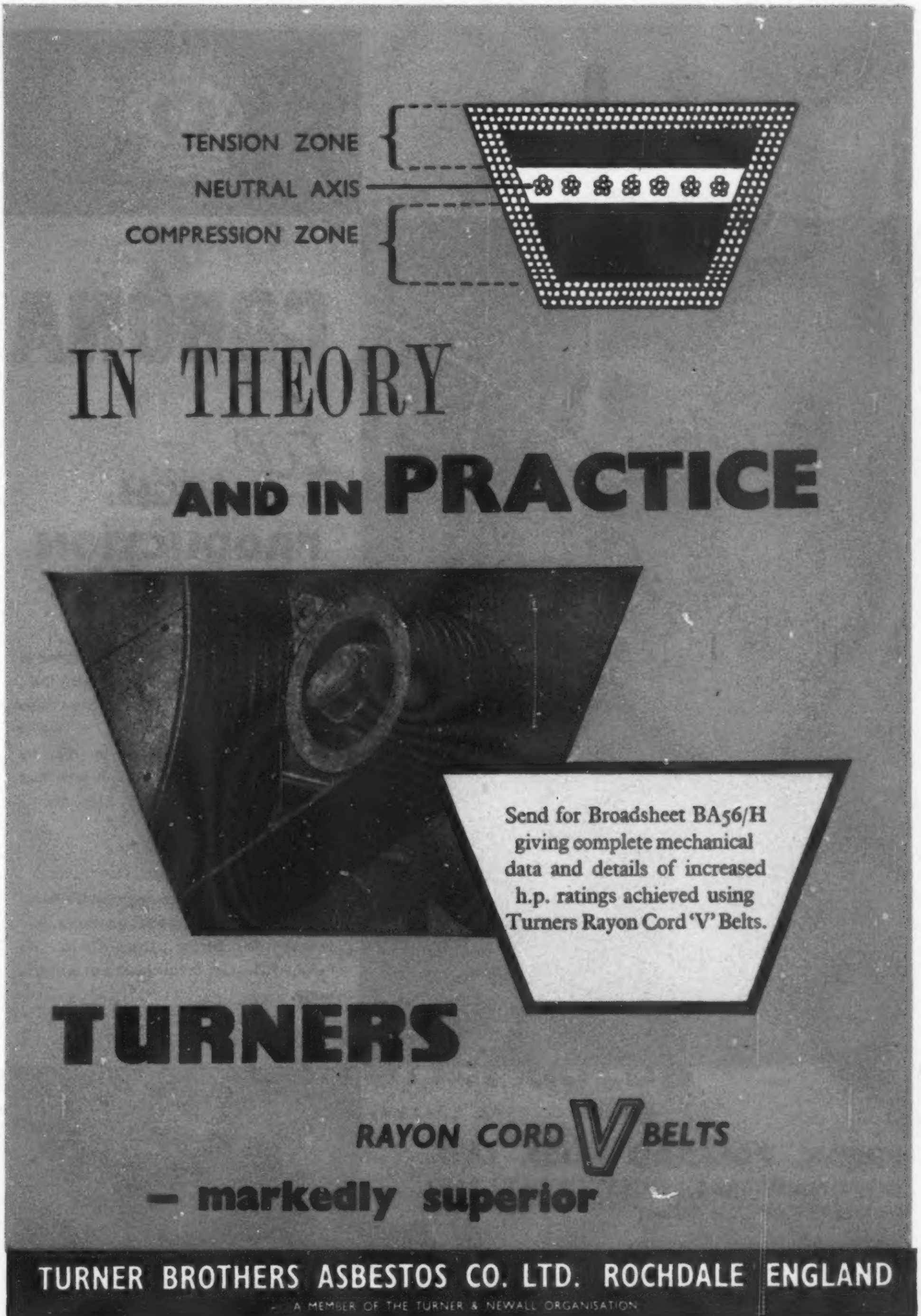
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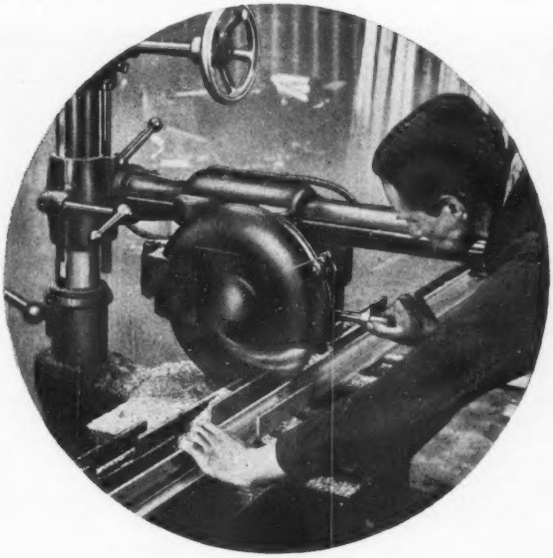

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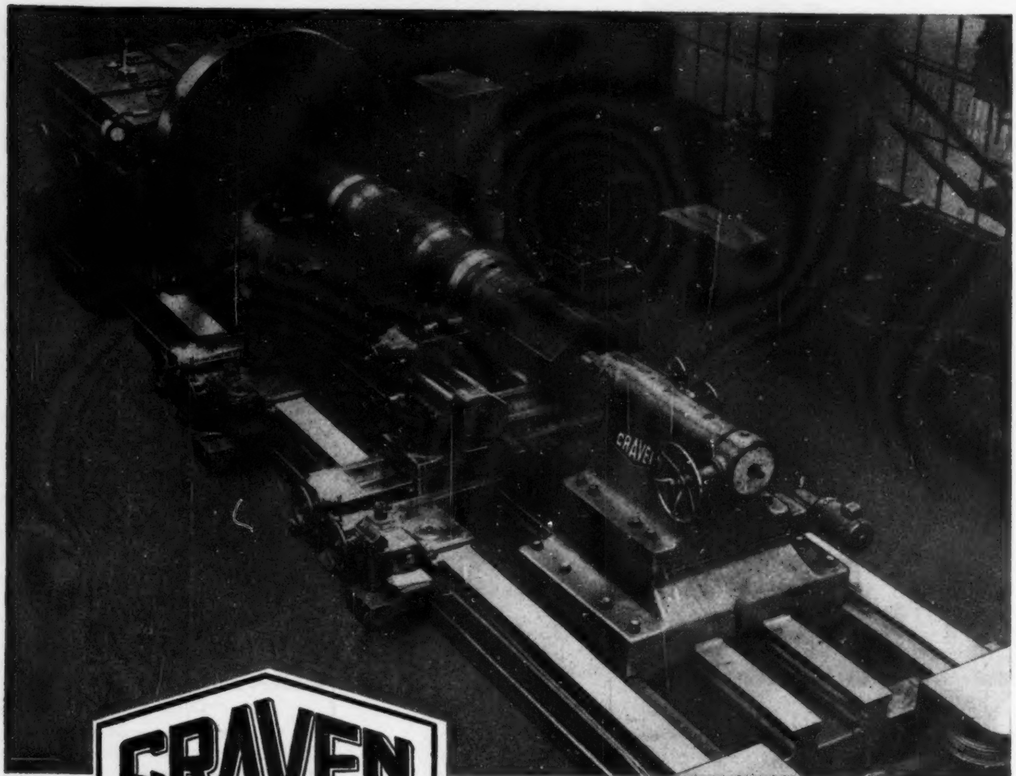

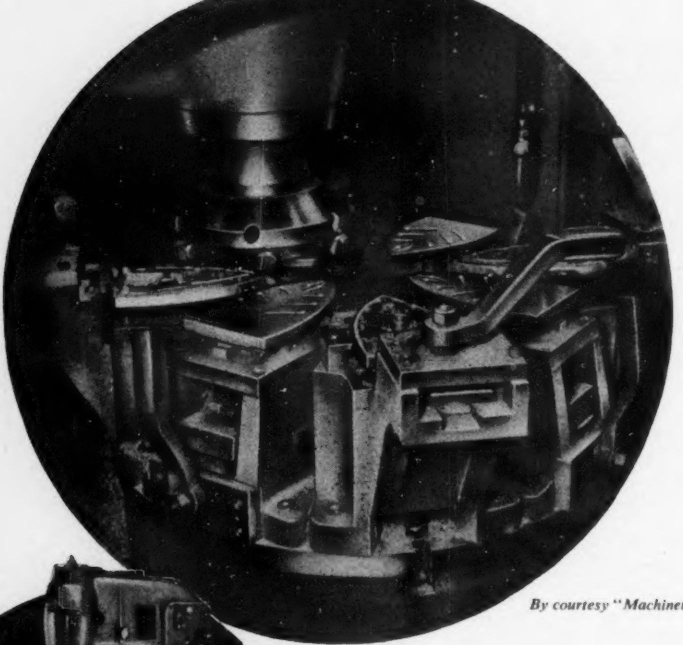

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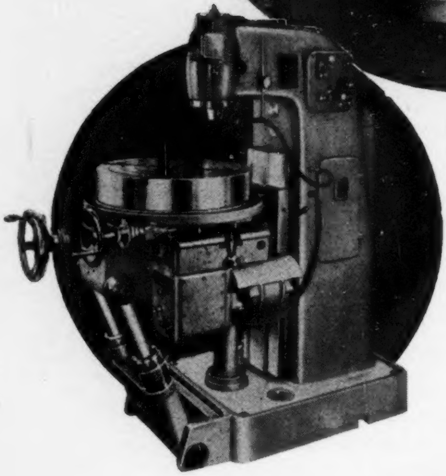

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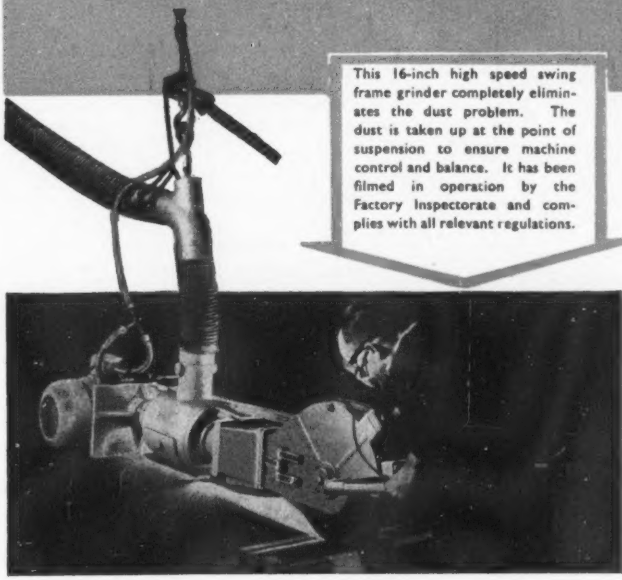

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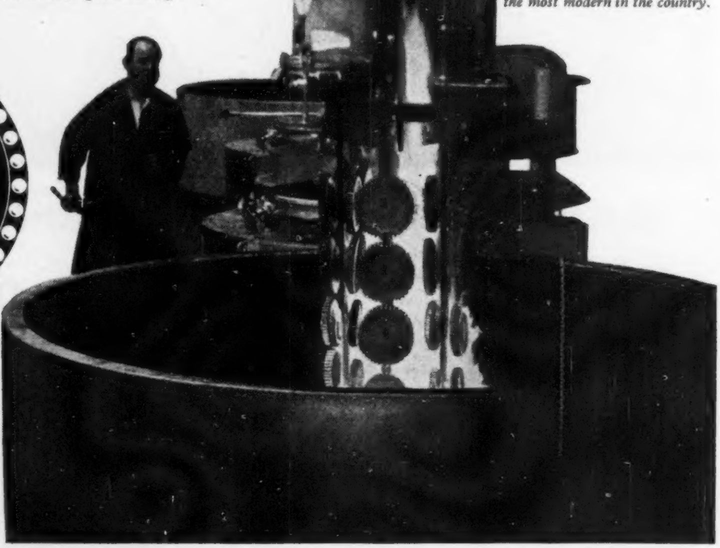

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Abstracts of Principal Articles

Production of Cash Registers and Accounting Machines ......P. 692

The National Cash Register Co. (Mfg.), Ltd., now employ some 3,000 people in their Dundee factories, where production was started in 1947, and since that date more than 300,000 machines have been built by flow-line methods. The nature of the company's products necessitates the manufacture of a very large number of different components. Consequently, although more than three million parts are being made in the machine shops each week, the batch quantities in many instances are relatively small. Special care has therefore been necessary in the selection of economic manufacturing methods and in the establishment of a suitable system of production control. Attention is drawn in this article to the company's approach to the problems involved, and details are given of a number of interesting production methods that have been developed, some of which have applications in other fields. (MACHINERY, 93—24/9/58.)

Performance Tests for Balancing Machines P. 705

In this article, which is the second of two, the workpiece drive is first considered, and the requirements as regards maximum weight of the drive supported by the workpiece are indicated. Methods of testing to determine the unbalance resulting from different driving arrangements are then described. The desirability of separate and direct indication of the amounts of force and moment unbalance for certain types of workpieces are next discussed. Such workpieces include turbine assemblies for jet propulsion units, turbo superchargers, fans, centrifugal pumps, and flywheels which are to be balanced on overhanging arbors. Other sections of the article are concerned with practical correction units, speed of rotation of workpiece during balancing, specifications for driving motors, installation and service requirements, floor-to-floor and set-up times, single-plane balancing machines, and response to extraneous vibration. (MACHINERY, 93—24/9/58.)

Examples of Tooling for the Derota Transfer Press ......P. 719

Attention is first drawn to some recent developments in the design of the 3-ton capacity Derota transfer press, and the tooling employed on this machine for producing a typical component is then described in detail. This radio valve part is blanked and formed from 1⅛-in. wide by 0·008-in. thick nickel strip at the rate of 100 per min. Reference is also made to a combined roll straightener and feed unit which has been designed for use with this press. This attachment provides a strip feed in a direction parallel with the transfer plate and bed, with a maximum stroke of 3 in. A similar lateral feed attachment, with a stroke of 5 in., is available for a 9-ton press of similar type, which has recently been introduced. (MACHINERY, 93—24/9/58.)

The Ejection of Deeply-cored Die Castings P. 723

The great majority of die casting dies now being built are designed for ejection of the casting either by means of push-rods or by an independent hydraulic cylinder, both of which arrangements offer the advantages of simplicity with regard to construction and operation. These methods have their limitations, however, particularly when die castings must be produced from deep cavities, and some of the problems associated with ejecting such castings are discussed. Line drawings are given of typical push-rod and hydraulic cylinder ejection mechanisms, also of cores arranged for withdrawal by means of a finger cam. The variations in wall-thickness which can result from slight displacement of the core are then discussed. Next, the use of a retractable core arranged to slide in the direction of die travel is described, and the improved accuracy which can be obtained with this arrangement is considered. Dies arranged to be displaced transversely prior to the ejection of the casting are discussed, and, finally, some of the difficulties associated with die castings which incorporate long steel inserts are outlined. (MACHINERY, 93—24/9/58.)

Denham 20¾-in. Centre Lathe for Profiling Marine Diesel Engine Piston Heads...P. 734

Denham's Engineering Co., Ltd., have recently supplied a 20¾-in. heavy-duty profiling lathe to Swan, Hunter & Wigham Richardson, Ltd., for internal copying operations on large-diameter, long, piston heads for marine diesel engines. The lathe incorporates hydraulically-operated copying equipment, which works in conjunction with laminated plastics templates. The boring bars employed have been specially developed by Denham's and are of high-duty cast iron fitted with steel plates to damp out vibration. Tungsten-carbide tools are used, and the entire profiling operations on a piston head are performed in a floor-to-floor time of 12 hours, in contrast to the 30 hours which were required when the parts were machined by conventional turning and boring methods with the aid of sheet-metal templates. (MACHINERY, 93—24/9/58.)

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If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

Aspects of Russian engineering industry.

The Machine Tool Situation

During the first six months of this year, deliveries of British built machine tools averaged £7,356,000. This figure, although appreciably below the very high average (£7,936,000) for the full year 1957, compares very favourably with the monthly averages for 1956 (£7,123,000), 1955 (£6,282,000), and 1954 (£5,466,000). It must be noted, however, that whereas the average for the first quarter (£7,989,000) was slightly greater than the yearly average for 1957, in the second quarter there was a sharp fall to £6,724,000. Despite the drop in the value of deliveries, moreover, there was a further decline during the first half of the year in the reported value of orders in hand. At the end of 1955, this figure was as high as £100,186,000, but it fell successively to £98,431,000 at the end of 1956, to £78,501,000 at the end of 1957, and to £65,493,000 at the end of June last. It will be apparent, therefore, that whereas deliveries exceeded new orders by an average of £1,653,000 per month in 1957, the discrepancy during the first half of this year had risen to £2,168,000, while at the same time deliveries had fallen by £580,000 per month. At the current rate (6-month average) the orders in hand at the end of June represented nearly nine months' deliveries, whereas at the end of 1955 the total corresponded to almost 16 months' deliveries (at the 1955 average rate).

In 1957, deliveries for export averaged £2,037,000 per month so that the home market accounted for £5,899,000. For the first half of this year, export deliveries fell to an average of £1,811,000, and the value consigned to the home market was therefore £5,545,000. It will be noted that export deliveries during 1957 represented rather more than 25 per cent of the total, and the value of orders in hand at the end of the year was divided between the home and export markets in much the same proportion (24·7 per cent for export). In the first half of this year, the percentage of deliveries destined for export fell slightly, and at the end of June export orders in hand accounted for almost exactly a quarter of the total.

The monthly average value for machine tool imports rose from £1,413,000 in 1955 to £2,137,000 in 1956. In 1957, however, the average fell to £1,814,000, and in the first half of this year there was a further decline to £1,537,000.

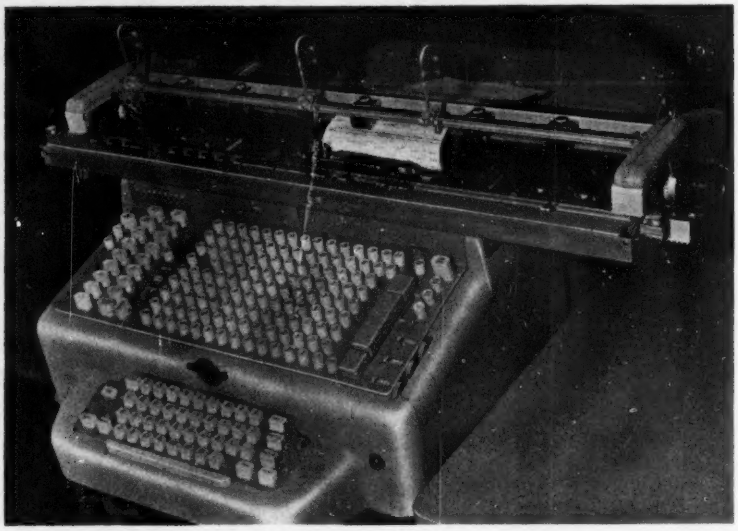
When the import figures are adjusted to take account of the small values of re-exports, it is found that the apparent total intake of machine tools by the home market averaged £7,419,000 per month in 1956, £7,650,000 in 1957, and £7,050,000 in the first half of this year.

It is, of course, very desirable that export trade in machine tools should be maintained and expanded, always provided that this can be done without diverting supplies which are urgently needed for British factories. Unfortunately, it appears that the advantages which might otherwise have resulted from ability to quote shorter delivery periods are at present being more than offset by intensified competition and other factors, and it is likely that special efforts will be necessary in this field for some time to come. In passing it may be noted that, as compared with the corresponding period of 1957, the principal decreases during the first half of this year were in exports to the U.S.A. and the Soviet Union.

From the standpoint of the national economy, however, the most important figure is the monthly or yearly value of machine tools taken by the home market, and we are certainly not yet in a position to tolerate any reduction in this respect. During the post-war years the demand for machine tools has generally tended to exceed supply, and the long delivery times that have necessarily been quoted, particularly for certain types of machines, have been the cause of frequent complaints. To meet this situation, the capacity of the machine tool industry has been substantially and progressively expanded, and the monthly value of output has risen year by year—apart from a slight setback in 1954—from £3,338,000 in 1950 to £7,936,000 in 1957. In view of the large amount of obsolete production equipment that is still in use, however, it is evident that the existing machine tool production capacity is by no means excessive and that we cannot afford to allow any significant part of this capacity to remain idle.

Following the general relaxation of credit restrictions, manufacturers as a whole should take advantage of the improved availability of machine tools to proceed with the replacement of old plant in the interests of greater efficiency, and not wait until they are compelled to do so by the pressure of rising demand. An excessive volume of uncompleted orders is not necessary for the well-being of the machine tool industry, but the influx should be at a level which provides for full employment and effective planning.

Production of Cash Registers and Accounting Machines



Methods Employed by The National Cash Register Co. (Manufacturing), Ltd., Dundee

The National Cash Register Co. (Mfg.), Ltd., which was established in Dundee, in 1947, to produce the well-known National cash registers, accounting machines and adding machines, was the first of the large American firms to begin manufacture in Scotland after the war. It is considered, indeed, that the success achieved by National Cash Register at Dundee largely influenced the decisions of some other American companies to choose Scottish sites for their factories.

The original Camperdown factory, of some 100,000 sq. ft., built by the company, is now devoted principally to the assembly of accounting and adding machines, with smaller sections concerned with the manufacture of fractional-horsepower electric motors, and the machining of certain cast-iron frame components. Other machined parts are now wholly produced in a separate factory on the adjacent Dundee Industrial Estate, which was built by Scottish Industrial Estates Ltd., in 1952, and provides 250,000 sq. ft., of floor space. In another, smaller, factory on the Estate, the various types of National cash registers are assembled. About 3,000 people are now employed, and more than 300,000 cash registers, accounting and adding machines have been built since 1947. A further extension of about 150,000 sq. ft., is being planned, with a view to expanding the scope of the manufacturing facilities to include die casting, plastics moulding and powder metallurgy, also to provide for making new products.

Attention may here be drawn to the company's advanced policy in affording the best possible working conditions in all branches of the organization. A comprehensive welfare service of a very high standard is available on both the day and night shifts, and full facilities for various kinds of sports, including a newly-built sports and social pavilion, are provided adjacent to the Camperdown factory, which is built on a site of 45 acres. The company's apprentice training school has recently been re-organized, and a very successful suggestions scheme is being operated, to which further reference will be made. As a measure of the company's success in the field of labour relations, it is stated that the labour turnover is 11·5 per cent per year.

Current output is made up of about 100 accounting machines, 150 adding machines, and 350 cash registers per week, the accounting and adding machines representing about 80 per cent of the production activities. Three main classes of cash registers are being built, and there are various versions of the accounting and adding machines which meet a wide range of requirements. A Class 31 fully-automatic accounting machine is

Fig. 1. View of the Assembly Line for the National Class 31 Accounting Machines at the Camperdown Factory

seen in the heading illustration, and Fig. 1 shows a view of the assembly line at the Camperdown factory.

The machine progresses from stage to stage on a wheeled fixture, also seen in Fig. 2, which is fitted with an indexing carrier so that the assembly, clamped by its base casting, can be rotated through 360 deg. and locked in various positions. Sub-assemblies are built up and fully tested on adjacent benches along the line, and the final inspection procedure on each machine includes a 2-days running test. The carriage drive on this machine is transmitted through a vane-type fluid coupling which ensures a very smooth movement and slips when the carriage reaches the various stop positions.

Of the three types of cash register now being produced, the class 100, which is entirely mechanical, is at present being called for in the largest quantities, and assembly is carried out by conveyorized methods, as seen in Fig. 3. Sub-assemblies are delivered to the main assembly line by overhead chain conveyor, and another conveyor delivers the covers for incorporation at a later stage. Flow-line methods, with roller conveyor systems, are employed for assembling the Class 21 and the Class 6000 cash registers, which incorporate electrical drive features. On the production line, lubrication of the assembled cash register mechanism is conveniently carried out by applying grease from a Bullows hot spray gun.

An accounting machine contains between 5,000 and 6,000 different parts, according to type, and a Class 100 cash register, for example, contains about 1,000 parts. Thus, although some three million components are being produced per week on day and night shifts in the machine and

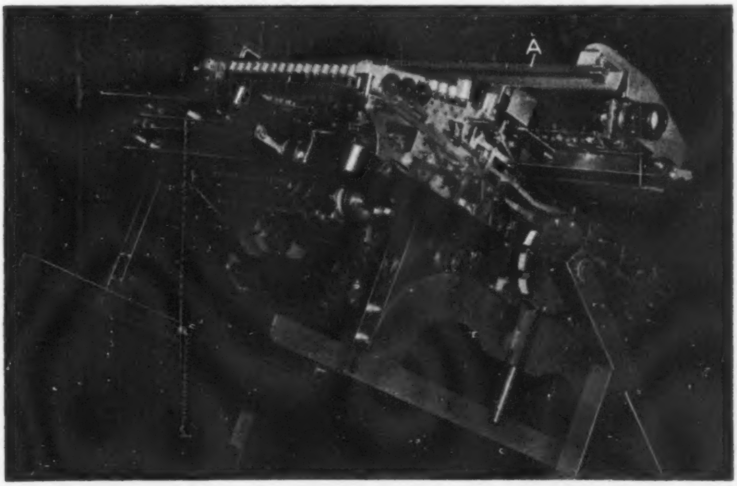


Fig. 2. The Accounting Machine Progresses from Stage to Stage on a Fixture Trolley and can be Indexed Through 360 deg.

Fig. 3. Conveyorized Assembly Line for National Class 100 Cash Registers

finishing shops, to meet the requirements of the assembly lines, the batch quantities involved are not as large as might be expected. Particular problems are therefore presented in ensuring a smooth flow of parts, produced economically, without maintaining a high level of stocks. Full account has been taken of these requirements in the machine shop layout, the batch order and progress control system, manufacturing methods, and inspection procedures, with the object of maintaining the inventory turnover in the finished parts stores at an average of four times per year.

In the machine shop, the machine tools, in general, are grouped according to type, with the plating, spray painting, polishing and heat-treatment departments conveniently situated along one side. Raw material enters at one end of the building, and in the stores facilities are provided for carrying out tensile strength, elongation, and Rockwell hardness tests. Any material which is to be the subject of special investigation as regards quality is held in a "bonded" store, and accepted bar and sheet stock is painted on the ends, according to a colour code system for specification. A tag is also attached to each batch on which is entered the name of the supplier, dates of delivery and acceptance, size, and specification. Rhodes hydraulic guillotine shears are among the machines installed for preparing strip material for the press shop.

For convenience in routing the batches of the work, the different types of operations have been allotted code numbers so that the various machine sections can be identified on a simple form of batch ticket. Separate instruction cards are issued for each operation on a component, which are filed in the supervisor's office and give details of the tool and gauge numbers, type of machine, speeds and feeds, and any special information gained as a result of experience. Both group and individual piecework schemes are employed, depending upon the nature of the work, and the rates are set so that an operator, by steady application to the task, can earn a bonus of 100 per cent.

Over the whole range of production, an average of eight operations is required per part, and on some components as many as 45 operations are performed. In this connection, setting-up time is taken into account when determining the economic batch quantity, and where similar parts are produced, one set of tools with adjustable members is provided wherever possible, so that the change-over can rapidly be made, often without removing the jig or fixture from the machine.

Production quotas are specified on a daily basis, which ensures that any manufacturing problems are immediately dealt with, and for every batch order a "due" date is allocated. As a general practice, three days are allowed for each operation when the work is being scheduled, and the date on which the job should be started in a particular section is readily ascertained by the shop clerk, by reference to the number of operations. Usually, for components requiring up to 10 operations, a two-week's reserve stock is maintained in stores, and for parts with more than 10 operations, a month's reserve stock.

Because of the large number of different components, and the relatively small batch quantities, it is not the policy of the company to duplicate press tools, jigs and fixtures as an insurance against production delays because of tool wear or breakage. Efficiency is maintained in this respect by ensuring that when a set-up is changed the tools not in use are returned to the stores, together with "last-off" sample components where necessary, by way

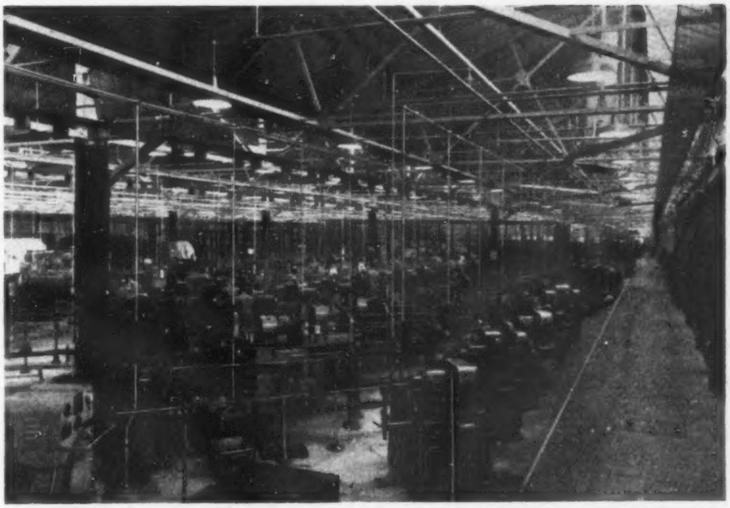


Fig. 4. The Automatic Section in the Main Machine Shop of the National Cash Register Co. (Mfg.), Ltd.

of a tool inspection section, so that any repairs can be promptly carried out. Records cards are maintained, and jigs and fixtures permanently set-up on machines are inspected at specified intervals. A well-equipped tool room, with a staff of about 200, is provided at a position convenient to the machine sections. The attention of machine operators is drawn to the need for care in the use of cutting tools, by displays, from time to time, of broken tools, with an indication of the cost. Posters are also employed, which indicate the cost of various types of cutting tools.

Plant utilization and initial tool costs in relation to the batch quantities to be handled are important factors in determining the degree of specialization that is economic, and both conventional tooling and specialized equipment are therefore to be found. The production methods here described have been selected as affording an indication of the company's approach to the manufacturing problems presented.

PRODUCING SHAFT COMPONENTS ON AUTOMATICS

A view from one end of the machine shop, showing the automatic section, is given in Fig. 4. Here, some 110 machines are installed, including B.S.A. and C.V.A. single-spindle turret automatics, sliding headstock machines of 4-, 10-, 16- and 25-mm. capacity by Petermann, and Wickman, Schutte, and Davenport multi-spindle types. The U.S.-built Davenport automatics, of $\frac{9}{16}$-in. capacity, have recently been installed. More than 5,000 different components, it may be noted, are pro-

Fig. 5. Cutting Oil and Swarf Reclamation Section Adjacent to the Automatic Screw Machines

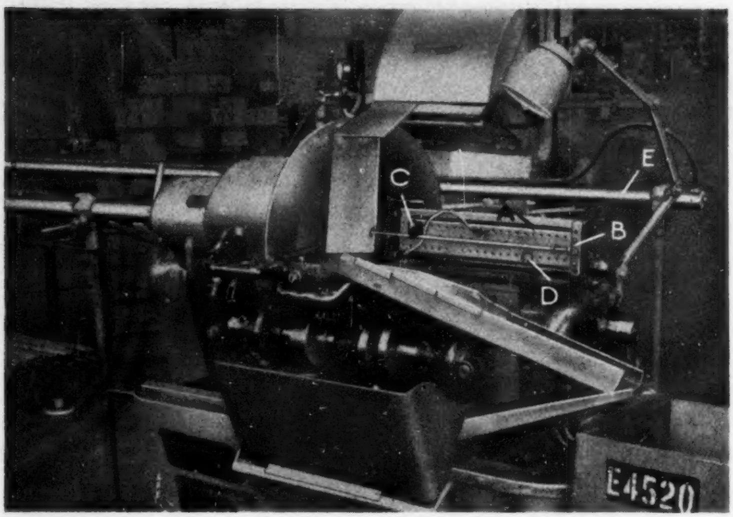


Fig. 6. Brown & Sharpe No. OG Automatic Adapted for Producing Shaft Components

duced in the automatics shop, in batch sizes ranging from 1,000 to 200,000.

Swarf separation and reclamation of cutting oil is carried out in a section, seen in Fig. 5, adjacent to the automatics. A Manlove & Alliott centrifuge is provided for oil and swarf separation, and the swarf is then fed into Cookson-McKenzie vibrator type machines which separate any random components. The smaller of the two separators is mounted on a stand, as indicated at A. A Sharples centrifuge, seen on the left, is employed for purifying the reclaimed oil which is taken from an adjacent supply tank, also for treating oil drained from machine coolant sumps by means of an Alfa-Laval Sump-Suk unit mounted on a wheeled trolley.

Particular importance is attached to chamfering the bar stock before it is delivered to the automatics, as a means of reducing wear on feed fingers and collets, and avoiding the risk of tool damage due to imperfect bar ends. The chamfering operation is carried out on a Maiden Machine installed in this section, and before the bars are passed to the automatics they are cleaned in a tank of white spirit. In the automatic section, the off-hand grinding of circular form tools is not permitted, the operation being performed on a Churchill surface grinder installed for this purpose.

In the manufacture of National accounting machines, adding machines and cash registers, some 250 shaft components, made from cold rolled steel, and ranging from 0·078 to ⅜ in. diameter, and 2 in. to 18 in. long, are required, some of which are plain, while others have diameter steps, and, in some instances, peripheral grooves. For producing these shafts economically, from bar stock, the company have adapted a Brown & Sharpe No. 00G and two No. 0G automatics by removing the feed tube of each machine and fitting a Puckert air-operated bar feed unit. The operating clutch on the back-shaft has also been modified, and the turret has been removed and replaced by a stationary stop plate, as seen at A in Fig. 6, which shows one of the No. 0G machines.

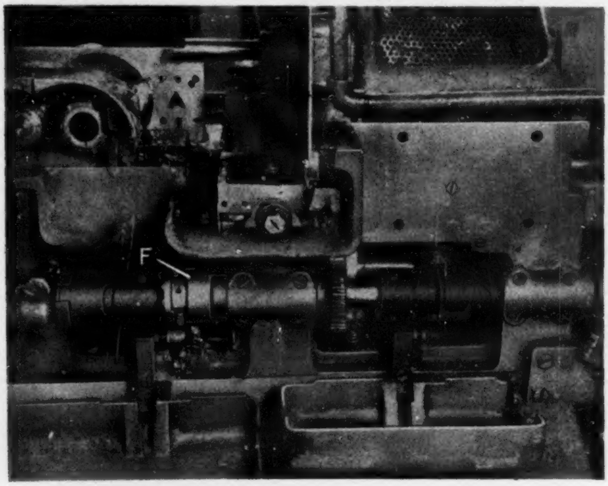


Fig. 7. Rear View of the No. OG Automatic, Showing the Modified Collet-operating Clutch

Tapped holes in the plate enable a block *B*, with an adjustable stop screw, to be clamped in various positions, and these holes also accommodate upper and lower grooved blocks *C* and *D*, which guide the bar as it is being fed up to the stop. These blocks are so positioned that the parted-off piece falls freely into the delivery chute beneath.

Air from the shop line is fed continuously, at a pressure of about 20 lb. per sq. in., to the outer end of each Puckert unit, the air connection on the feed tube of an automatic located to the left being seen at *E*. Thus, when the collet is opened, the bar feeds automatically up to the stop. Referring to the rear view of the machine shown in Fig. 7, the collet operating clutch *F*, on the back-shaft, has been modified to enable opening and closing of the collet to be controlled by separate dogs on the front camshaft. A sufficient length of time can thus be provided during the cycle for the bar to feed out when producing long shaft components. In this view, the stop plate on the turret slide is again indicated by *A*. To improve production still further on these shaft automatics, Lipe magazine bar feed units (Gaston E. Marbaix Ltd.) are to be fitted.

A circular form tool of high-speed steel, on the front slide, produces chamfers on the ends of the shaft components, and parting off is carried out from the rear. An end neck, where required, is also produced by the circular form tool. Other reduced diameter portions and grooves are machined at second operations on Modern capstan lathes, conveniently located adjacent to the automatics. It is important that the shafts should be accurately straight, and before any further operations are performed after they have been parted-off on the automatics, they are checked by rolling on a surface plate, and straightened manually, as required. A centreless grinder is used for finishing shafts where close tolerances must be maintained on outside diameters.

Tolerances of $+0{\cdot}001$ in. are commonly specified for shoulder lengths, and dimensions are given from a datum shoulder to obviate cumulative errors, as indicated on the drawing Fig. 8, which shows a typical small-diameter shaft. For rapidly checking shoulder lengths, a Hilger projector

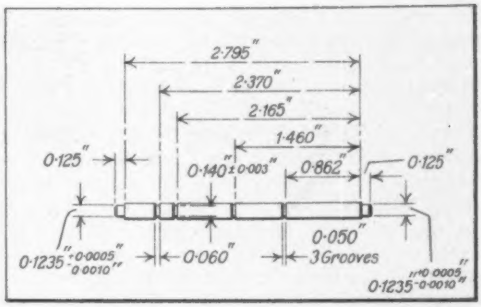


Fig. 8. Typical Shaft Component Produced on One of the Modified Brown & Sharpe Automatics

of 25× magnification is provided, which is equipped with a gauging fixture capable of handling the entire range of shafts made. This projector is seen in Fig. 9, set-up for handling the shaft shown in the drawing.

The base of the fixture, clamped on the projector table, is provided with two round guide bars whereon moves a carriage *A*, fitted with four ball-bearing mounted rollers, which have grooved peripheries to provide lateral location. Interchangeable gauging blocks *B*, retained by a spring loaded side pad in a tenon groove on top of the carriage, are provided for handling the various types of shafts. These blocks are fitted with vertical pins which are located in jig bored holes corresponding to the shoulder positions on the component, and are ground at the tops to form vertical reference faces. The component rests on these

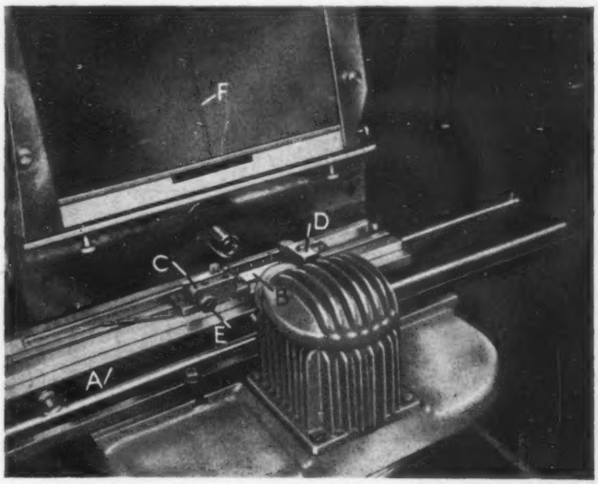


Fig. 9. Hilger-Watts Projector Set-up for Checking Shafts

pins, and against two side support pins, and it is retained endwise between two leaf springs carried on blocks *C* and *D*, which are clamped in a T-slot on the carriage. The left-hand spring is attached to a pivot arm which can be adjusted, by means of the knurled screw *E*, to bring the datum shoulder of the workpiece axially into line with the vertical reference face of the pin on the gauging block. This setting is made by observing the images of the shaft shoulder and the reference face on the screen of the projector. The accuracy of the remaining shoulders can then be readily ascertained by moving the carriage until the pin reference faces coincide, in turn, with the central line of three on the chart, the two outer lines representing the tolerance allowed. For the shaft shown, the cycle time on the automatic is approximately 5 sec., and for the grooving operation on a capstan lathe the output is 130 per hour.

DEBURRING TURNED PARTS

For removing the burrs from the part-off ends of turned components, bench-mounted horizontal spindles of simple design, fitted with deburring tools are extensively employed. The workpieces are held in specially-designed pliers, and are applied to the tools by hand, this method having been found the most effective, both as regards speed of operation and quality, for parts handled in relatively small batches. Standard twist drills, suitably ground, are used, also high-speed steel cutters of the cone type shown in Fig. 10, which are made in a range of 12 sizes for deburring holes from $\frac{1}{8}$ to $\frac{5}{8}$ in. diameter. The dimensions given are for a cutter suitable for $\frac{1}{8}$-in. diameter holes. On the $\frac{5}{8}$-in. size, the diameter *A* is $1\frac{5}{16}$ in., and the hole *B* is $\frac{15}{32}$ in. diameter.

For handling certain components required in large quantities, the company has designed two automatic air-operated machines, which are fitted with Syntron vibratory-feed hoppers, as shown in Fig. 11. Each is capable of dealing with 3,000 parts per hour, and the mild steel component concerned is shown inset in the figure, with the edge to be deburred indicated at *x*.

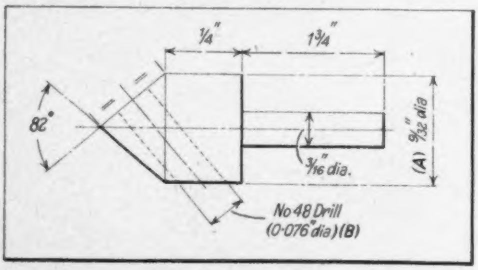


Fig. 10. High-speed Steel De-burring Tool

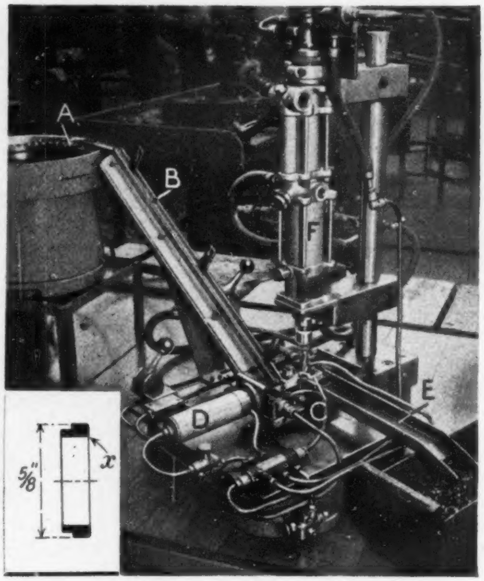


Fig. 11. Automatic De-burring Machine Incorporating a Maxam Air-driven Spindle Unit

A selector plate is provided at *A* on the hopper feed ramp which deflects back into the bowl any components which are not the right way up. Parts correctly orientated move by gravity down the guideway *B*, and are transferred, in turn, into contact with a fixed V-block *C*, at the deburring position, by means of another V-block mounted on the piston rod of a Maxam air cylinder *D*. Upon completion of the deburring operation, the clamping V-block retracts, and the piece is ejected into a discharge chute *E*, by means of an air jet controlled by the spindle head movement.

Deburring is performed with a standard twist drill carried in the chuck of a Maxam self-contained head *F*, which incorporates air-hydraulic feed cylinders and an air-driven spindle, the latter being lubricated by oil mist from a Norgren unit. Maxam valves are incorporated for controlling the fully-automatic cycle of the machine.

SHAFT ASSEMBLIES

On many of the shaft components are assembled parts such as levers, cams and latch plates, which are held in position by taper pins. For locating

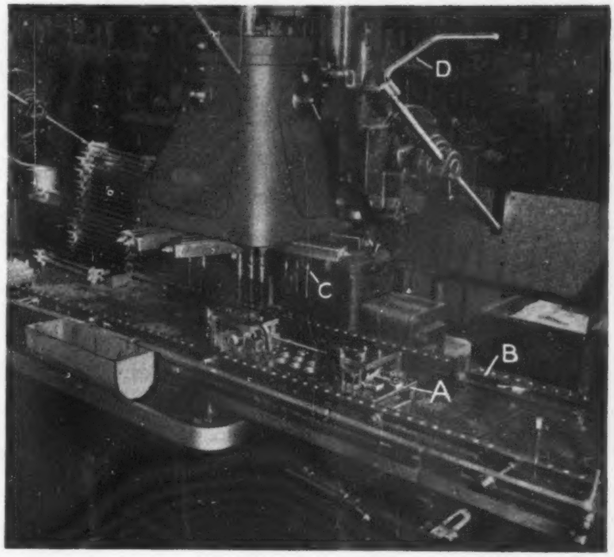


Fig. 12. Four Herbert Drilling Machines, Fitted with Adjustable Multi-spindle Heads, and Connected by a Special Table, are Employed for Drilling and Taper "Broaching" Holes in Shaft Assemblies

these parts on the shafts, drilling and taper "broaching" the pin holes, and assembling the taper pins, jigs of the type seen at *A* in Fig. 12 are used on a group of four Herbert pillar drilling machines. The latter are fitted with multiple adjustable spindle heads, and are connected together by a continuous cast-iron table. Front and rear guide rails, as at *B*, fitted with stop blocks which can be adjusted to any required positions, are provided for locating the jigs beneath the spindle heads.

Nest locations and clamps screws are incorporated in the jig for holding the shaft and the parts being assembled, and the drill bushes are carried in hinged, retractable plates, which are held in the working positions by latches at the front. With the set-up shown, five parts are being assembled on the shaft, three at one end and two at the other. The holes, of 0·089 in. diameter, are first drilled at two operations using the spindles at the front, and the bush plates are then swung back in preparation for taper "broaching" with the rear spindles *C*. The feed is applied by hand, and, to facilitate operation, an extension *D* has been welded to the existing handle.

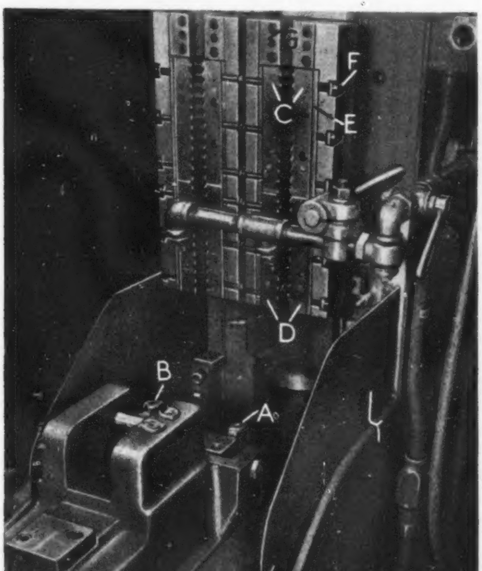


Fig. 13. Set-up for Broaching Serrations in Two Pressed Steel Cam Components, on a Cincinnati Type 1/30 Hydraulic Machine

BROACHING SERRATIONS IN PRESSED STEEL CAMS

Fig. 13 shows a set-up on a Cincinnati type 1/30 hydraulic broaching machine, for producing the two sets of serrations in the periphery of the pressed steel cam in Fig. 14. This component forms part of the operating mechanism of an electric typewriter on an accounting machine, and it is produced from 0·030/0·032 in. thick cold rolled soft mild steel, and subsequently case hardened. The operations required to produce the pressing, comprise blanking, drawing, piercing, swaging and striking, second striking, trimming, and piercing. The curved slots in the base are provided for tooling purposes only, to allow the metal to flow in the swaging die. During the second strike, which is performed in a tungsten carbide die, the top edge is swaged to produce the height dimension 0·155 in. + 0·001 – 0·002 in., and the slight burr

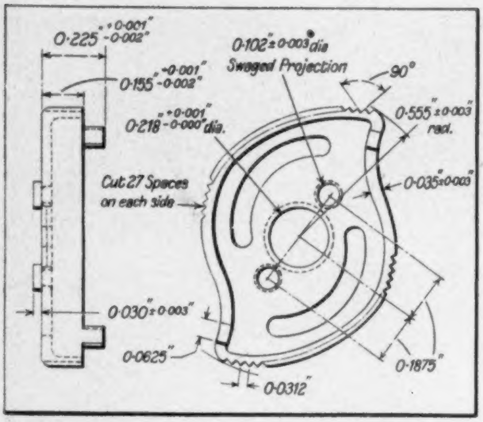


Fig. 14. Details of the Serrated Cam Broached with the Set-up Shown in Fig. 13

formed on the corner is removed by pushing the part through a trimming die.

Referring to Fig. 13, two workpieces, located by the internal form on fixture spigots at *A* and *B*, are broached complete at each stroke, the fixture being advanced hydraulically from the loading to the cutting position, and returned for unloading when the broach slide reaches the bottom of its stroke. In the illustration, the fixture is seen in the loading position and the guard enclosing the cutting area has been removed to enable the broaches to be seen more clearly. Originally, the fixture was provided with top clamps for the workpieces, but these were found to be unnecessary and have therefore been removed.

Each broach consists of upper and lower stages *C* and *D*, which cut alternate serrations in the workpiece, this arrangement having been adopted to avoid sharp corners in the roots of the broach teeth, and thus facilitate grinding the form. In addition, to simplify the form grinding operation, the right- and left-hand sections at each stage are composed of front and rear inserts, which are fastened together by screws and dowels. At each work station, therefore, the broach consists of eight separate pieces.

Provision is made, by means of side packing plates *E*, and locking screws *F*, for spacing the broach sections at the required distance apart in the holder, and the latter is fitted with end stop blocks *G*. The fixture location spigots *A* and *B* are carried on blocks which can be adjusted transversely for aligning the workpieces with the broach teeth. An output of about 150 pieces per hour is obtained with the set-up shown.

This Cincinnati machine is also employed for broaching serrations in several other pressed steel cam components of generally similar design, one of which requires serrations on one side only. In the accounting machine, these serrations engage a rubber roller for driving purposes.

BROACHING SLOTS IN CARRIAGE STOP BARS

An important component in the carriage mechanism of an accounting machine is the stop bar seen at *A* in Fig. 2, which carries a series of trip stops concerned with the automatic sequence control. Some details of the stop bar for the National Class 31 accounting machine are given in Fig. 15. It is made from 0·450- by 0·510-in. stainless steel bar and some 43 operations are involved in its production, including the broaching of the slots on a Cincinnati hydraulic machine.

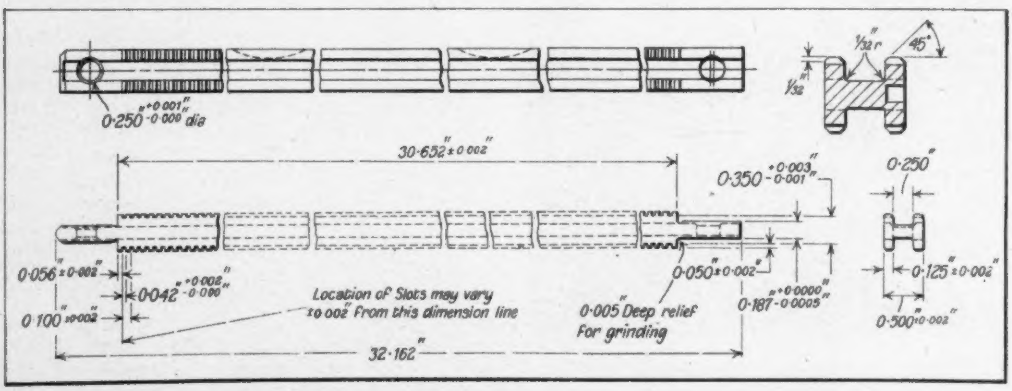


Fig. 15. Details of the Stainless Steel Stop Bar Fitted to the National Class 31 Accounting Machine

Fig. 16. Cincinnati Production Milling Machine Set-up for Machining the Form in Four Stop Bars at One Loading

There are 306 slots, 0·042 in. wide by 0·050 in. deep, and spaced at 0·100-in. pitch, in the two opposite faces. Graduations, not shown in the drawing, are also required on the bar.

The preliminary operations, after the material has been cut off, comprise: facing the ends and chamfering one end for datum identification purposes; straightening by manual methods, and checking on a surface plate; grinding two opposite faces on a Snow surface grinder to produce the 0·500 in., $\pm 0 \cdot 002$ in. dimension; and milling the 0·250-in. wide grooves in each side. The latter operation also provides for machining the 45 deg. chamfers, and is carried out at two stages, on four workpieces at a time, on a Cincinnati hydraulic production milling machine, as shown in Fig. 16. The two pairs of workpieces are clamped sideways in the location slots of the fixture by means of six cam clamps, as at *A*, which are tightened by the application of a box key. During tightening, the two pieces are held down by the removable hand lever *B*, which carries a round cross pin that bears on the two workpieces. This lever is forked at the front to engage the undersides of the heads of fulcrum studs, as at *C*, located between pairs of clamps. The operation on each side is carried out by climb milling, with high-speed steel form cutters of 4 in. diameter, at a speed of 126 r.p.m. and a feed rate of 2¾ in. per min. Before the broaching operation is performed, the parts are checked for straightness, and rectified as necessary.

Fig. 17 shows the set-up on the Cincinnati machine for broaching the 306 slots in each side. Here, the work is held in the fixture *A* by five hydraulically-operated clamps *B*, which bear on the top face. Broaching is carried out at five strokes of the ram, between which the fixture is auto-

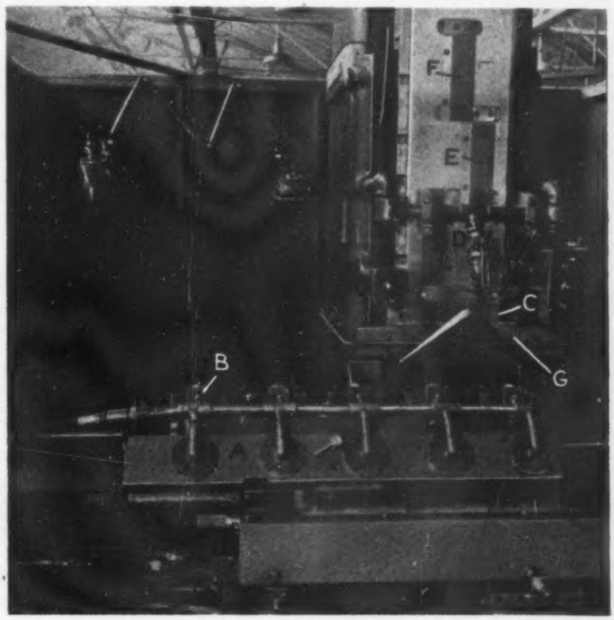


Fig. 17. Set-up on a Cincinnati Machine for Broaching the 306 Slots in Each Side of Carriage Stop Bars

Fig. 18. Removing the Broaching Burrs from a Carriage Stop Bar on an Abrasive Band Machine

matically indexed from left to right by means of a hydraulic cylinder. The cutting positions are accurately determined by stops on a rotary indexing carrier, which are engaged by an abutment on the fixture. The entire fixture and its slide base are moved away from the broach when the latter reaches the bottom of its stroke, and are returned to the cutting position after the upward movement of the broach slide.

There are four broach sections, and the lower section, *C*, is employed solely for topping purposes, the teeth being then cut progressively by the three inserts *D*, *E*, and *F*, so that the cutting load is distributed over the available stroke. In the figure, it may be noted, a guard surrounding the cutting area has been dismantled to enable the arrangement of the broaches to be observed. A wide brush *G*, carried on the machine frame, removes the cuttings from the broach teeth. When broaching the teeth in the opposite face, location is taken from the roots of the teeth already cut, so that the 0·350 in. dimension is maintained. For this purpose, interchangeable location plates are provided for the fixture. The output obtained at each broaching operation is 20 pieces per hour.

Burrs resulting from broaching are removed on a vertical abrasive band machine, as shown in Fig. 18. These machines, supplied by Taylor Tools & Supplies, Ltd., also horizontal abrasive band machines, are extensively employed for de-burring and smoothing operations on a variety of components. On the horizontal machines, it is the practice, where possible, for the operator to release the finished piece so that it is carried automatically by the band movement into a container at the end of the machine. Wooden boxes, divided into compartments as shown, are provided for the stop bars, to mininize the risk of damage during transit and storage. Boxes of this type, in several standard sizes, are employed throughout the factory, rather than metal containers.

PNEUMATIC-FEED RIVETING MACHINE

Riveting and copper brazing play an important part in the production of assemblies for National accounting and adding machines, and cash registers. The riveters installed include a number of Townsend machines, one of which has been converted to air operation as seen in Fig. 19 and 20, and specially adapted for the economical production of some 24 types of key stem assemblies, a typical example being shown in the drawing, Fig. 21. The principal difference between the various types is in the overall length of the stem and the spacing of the two studs.

The key stem comprises a length of cold drawn, square-edge mild steel, 0·058/0·060 in. thick by 0·196 ±0·001 in. wide, which is serrated at one end in a press tool. Two holes of 0·078 in. dia-

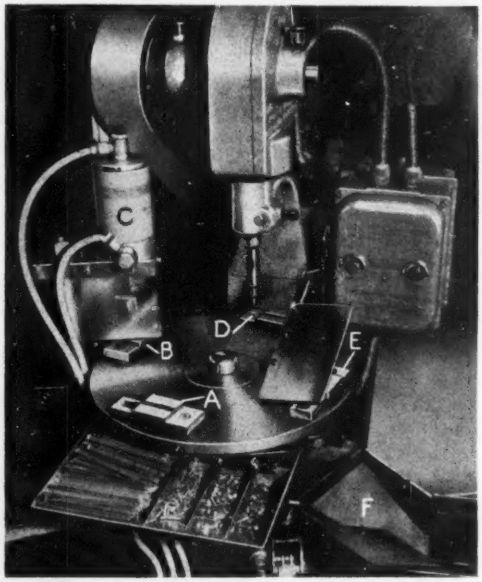


Fig. 19. The Townsend Riveting Machine Equipped with an Air-operated Indexing Table

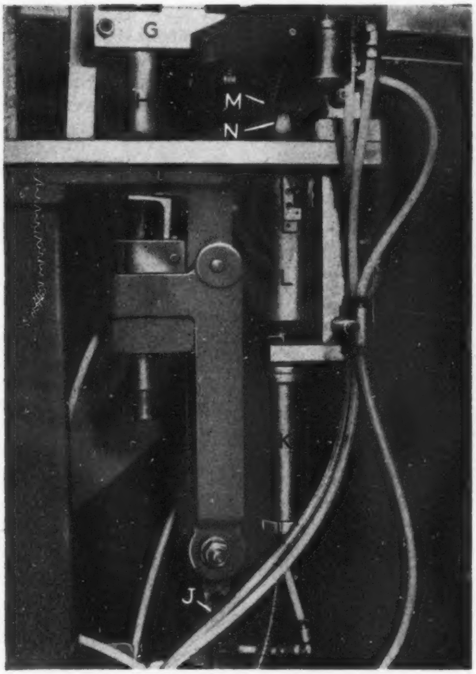


Fig. 20. A View Showing the Indexing Mechanism Beneath the Riveting Machine Table

meter are pierced in the stem to accommodate a round, shouldered stud *x*, which is a press fit, and a square-headed stud and washer *y*. The square-headed stud is riveted in position, and the assembly is subsequently copper brazed.

Referring to Fig. 19, an indexing work table with four fixtures is provided on the Townsend riveter, the round stud and the square-headed stud and washer being loaded, by hand, into location bushes in the fixture at *A*, and the stem component then placed on top. The cycle is initiated by a hand-operated valve and the table indexes in a clockwise direction. At station *B*, the stem component is pressed over the round stud by a punch on the piston rod of a Maxam air cylinder *C*, and the square stud is riveted at station *D*. An air jet, applied from beneath at station *E*, automatically ejects the finished assembly into a container *F*. Trays for the various components are provided at the front of the table, and the cycle time for performing the operation is 10 sec. Adjustment is provided on the fixtures so that they can be used for the entire range of key stems that is produced.

Fig. 20 is a view of the mechanism beneath the table, showing the indexing and lifting arrangement. The table assembly, including the air cylinder *C*, is carried on a bar *G*, clamped to the original table stem *H* of the machine. Vertical movement of the table, to bring the work up to the riveting punch, is effected by a horizontal air cylinder, in conjunction with an oil dashpot, which is coupled by a link *J* to the existing foot-lever yoke of the machine.

Table indexing is performed by a 1½-in. diameter by 4-in. stroke air cylinder *K*, on the piston rod of which is mounted a sleeve *L*. This sleeve encircles the stem *M* of the table, and is prevented from rotating by an external key. In the periphery of the table stem, there are eight, ⅛-in. wide, helical tracks arranged at 45 deg., as at *N*, which are engaged by four driving pins in the sleeve. The arrangement is such that during the upward stroke of the piston the table is turned through half the required angle, and the indexing motion of 90 deg. is completed during the return stroke.

BARREL FINISHING

The company has, for a number of years, made very effective use of barrel-finishing techniques for de-burring, polishing, removing heat-treatment scale, and producing radiused edges on components, and for this purpose an extensive installation of Roto-Finish equipment is provided in a separate section adjacent to the polishing shop. A view of this installation is given in Fig. 22. It comprises three DW22 duplex units, one DW16 unit and four DW12 units. Finished parts are separated from the chips in a magnetic drum and belt unit (Rapid Magnet Machines, Ltd.), and a mechanical vibrator separator with wire mesh screen is also provided, which is suitable for certain types of parts. All the work is degreased in Orpi 19 fluid

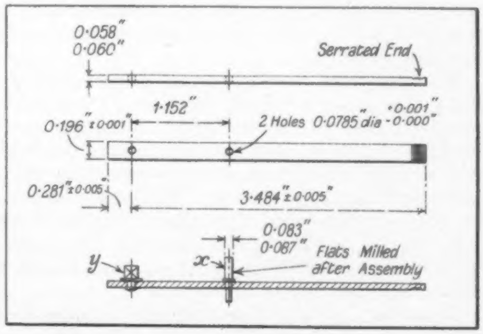


Fig. 21. Typical Example of a Key Stem Riveted on the Townsend Machine

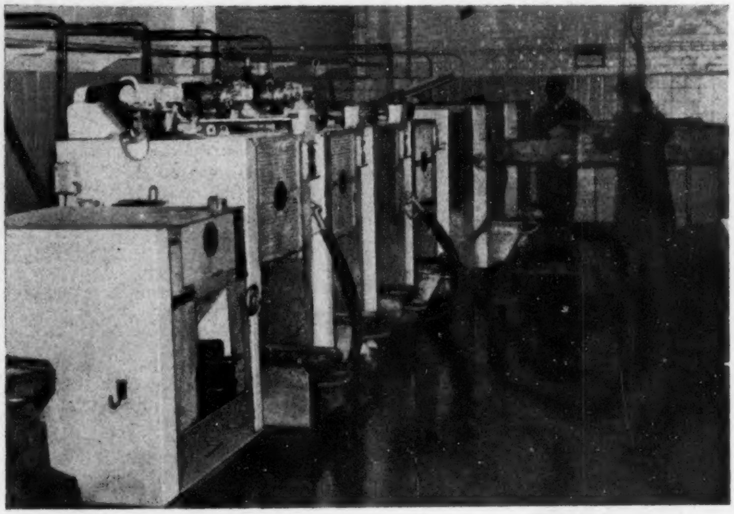


Fig. 22. View of the Roto-Finish Barrel Finishing Installation whereby More than Half a Million Components are Treated Each Week

(Orcene Co., Ltd.), before it is loaded into the barrels, and there are facilities for rapidly treating the finished work in de-watering fluid and rust preventive fluid.

Nearly all the workpieces handled are of steel, and include turned and milled parts as well as a wide variety of pressings. Relatively light drilling and milling burrs can successfully be removed, also burrs left on gears after hobbing. Threaded parts which have been heat treated are also barrel finished to remove scale. No special holders are found necessary for the types of work which are being handled, although, in certain cases, long, slender parts are layer loaded. In general, the work can be placed at random in the barrel. Where an extensive series of operations is required to produce a part, barrel finishing may be performed several times during manufacture, to remove burrs and thus ensure accurate location in jigs and fixtures.

Five types of barrelling compound suffice for the entire range of work handled. These compounds serve for (1) deburring, leaving a matt finish on the work; (2) deburring, leaving the work with a semi-lustre finish; (3) removing light burrs and polishing; (4) providing a fine polish suitable for plating, when used with special honing chips; and (5) removing heat-treatment scale. Parts that have been de-scaled in acid compound are barrelled again in a neutralizing compound.

More than half a million parts are barrel-finished each week, and both day and night shifts are worked. The installation is attended by four operators, and a supervisor, on each shift and because of the large number of batches handled a barrel is emptied approximately every 5 min.

Reference may also be made to a vapour-blast installation supplied by Abrasive Developments, Ltd., which the company employs for treating certain steel parts. The latter are subsequently chromium plated, on copper and nickel, and then sprayed with clear lacquer and stoved, to obtain a decorative satin finish. The plating shop is up to date in all respects, and, again, is laid out for handling, efficiently, the large daily number of work batches. One of the operations carried out is the zinc plating of steel gear blanks, in order to reduce wear on the hob teeth.

Other interesting production methods developed by the company will be described in a further article to be published shortly in MACHINERY.

PLASTICS PROTECTIVE SKIN FOR SMALL ITEMS AND DRAWINGS—All types of drawings, blue-prints, notices, documents, and printed matter, it is claimed, can be protected against damage from damp, dirt, grease and finger marks by the use of Morane plastics skin. This process, which has been developed by the Morane Plastic Co., Ltd., Ashford, Middlesex, provides for laminating and heat-sealing articles between sheets of plastics film on specially-designed presses, of which the company makes a range to cover a variety of applications. A variant of this process, known as "skin-packaging" enables items such as screws, nuts, bolts, washers, and precision parts to be vacuum-sealed to a card. The plastics skin adheres to the card and is formed tightly around the parts, so outlining them to facilitate identification, and providing protection from damage during storage, for example. These processes are suitable for small-, medium- or high-quantity sealing by unskilled labour.

Performance Tests for Balancing Machines

By W. I. SENGER*

A previous article in MACHINERY, 93/583—10/9/58, was concerned with equipment required for performance testing on balancing machines, and recommendations were made for tests on 2-plane balancers. Here, the testing of the workpiece drive is discussed, also the desirability of separately indicating and directly reading force and moment unbalance, single-plane balancing machines, and related subjects.

TESTING THE WORKPIECE DRIVE

The drive for the balancing machine should have negligible effect on the indication of unbalance. For this reason, the weight (in ounces) of that part of the balancing-machine drive which is supported by the workpiece (while the machine is indicating unbalance) multiplied by 0·0002 should be less than the maximum allowable unbalance U in ounce-inches. If any part of the driving device is attached to the workpiece and continually maintains a definite angular position with respect to it while unbalance indications are made, means should be provided in the device for applying unbalance corrections which are effective in two transverse planes. The workpiece should be driven by means of a coupling attached to one end, or a belt passing over a suitable surface or an attached pulley.

With the balancing machine at its most sensitive setting, the smallest test rotor should be balanced until there is less than one-half the allowable residual unbalance in each plane. All parts of the balancing machine drive which are supported by the rotor should then be removed, the rotor turned accurately through 180 deg., and the drive member again attached. Next, the workpiece is again run in the balancing machine and the unbalance indications are observed. In each plane, the unbalance indication should be less than 1½ times the allowable residual unbalance.

The rotor should now be balanced again, until there is less than one-half the allowable residual unbalance in each plane. An unbalance of $2U$ is introduced in the left-hand plane at zero deg. and a 2-U unbalance in the right-hand plane at 180 deg. Correction for these unbalance effects is then made by changing the condition of balance of the coupling. Means should be available in the coupling for reducing the unbalance indications to one-half the allowable residual unbalance in each plane.

The weight, in ounces, of that part of the balancing machine drive which is supported by the test rotor should be determined. If the drive is by belt, only that portion of the belt which is actually supported by the rotor should be weighed. The force imposed by belt-tension devices should not be included, but account should be taken of the weight of any pulleys or devices attached to the test rotor if the belt does not run directly over the body.

If the drive is from one end of the rotor, it is necessary to determine the weight (at the point of attachment to the rotor) of all parts removed to permit of turning the rotor 180 deg. As already indicated, the product of the weight of the drive (in ounces) × 0·0002 should be less than the maximum allowable unbalance U. These tests should be repeated for the largest size of test rotor.

The device used for driving workpieces in a balancing machine often introduces undesirable unbalance effects. Any driving device which continually maintains its angular position with respect to the workpiece becomes a part of the work so far as the unbalance indicator on the balancing machine is concerned. There are two methods that are generally used to drive the work: an end drive, or a belt drive by means of a belt driving directly over the periphery of the workpiece. Each method has its advantages and limitations.

End drive by means of a collet and adapter attached to the work will deliver the torque required to rotate larger pieces, but is generally undesirable where the weight is less than 50 lb. because such a drive is relatively heavy and introduces excessive unbalance effects. Moreover, it is difficult to keep an end drive in balance under operating conditions. A belt drive is ideal for lighter workpieces in that it adds little weight and consequently has little or no effect on the unbalance indications. Such a drive, however, is impractical for workpieces having large polar moments of inertia, large windage loads at balancing speed, or large diameters.

It is only at additional cost that any balancing machine manufacturer can supply both types of drive on a given machine. In the interests of

* Gisholt Machine Co., U.S.A.

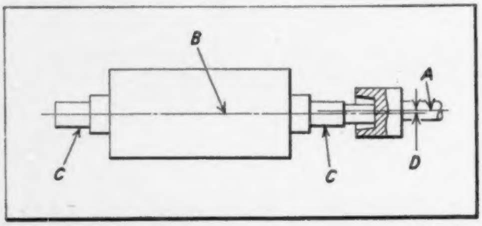


Fig. 1. The Centre Line *A* of the Work-driving Collet may be Offset from the Axis *B* of the Workpiece as Determined by its Bearings C Because of a Bent Shaft, Eccentric Surfaces, Manufacturing Tolerances, or Collet Wear

economy, only the most practical type of drive should be specified. An end drive device may introduce unbalance for two reasons—the driver itself may be out of balance, or eccentric mounting may introduce unbalance. To compensate for unbalance in the driver itself (which may change by reason of wear), a compensating arrangement should be incorporated.

If the drive is transmitted by a collet, as indicated in Fig. 1, it is quite probable that the axis of the collet will be 0·001 in, from the axis of the rotor (as determined by its bearings). This eccentricity may be due to a bent shaft on the workpiece, eccentricity of the surface gripped by the collet, the necessary manufacturing tolerance on this surface, or the impracticability of providing a collet which, during all its useful life, will continually hold to within 0·001 in. To insure against the introduction of excessive unbalance effects by reason of this eccentricity and the weight of the driver, the weight should be limited to a value such that when it is mounted off the rotational axis of the rotor by 0·001 in., less than one-half the allowable residual unbalance is introduced.

FORCE AND MOMENT UNBALANCE

Balancing machines should be capable of separately and directly indicating the amounts of force and moment unbalance. This facility should be specified if, in present or possible future production, parts are to be balanced in which (1) the planes of correction in the workpiece are less than one-fifth as far apart as the supporting bearing, (2) the planes do not lie between the supporting bearings, or (3) the planes are towards the same end of the rotor with respect to its centre of gravity. Turbine assemblies for jet propulsion units, turbo-superchargers, fans, centrifugal pumps, or flywheels balanced on overhanging arbors are representative parts which require to be balanced in this manner. The four readings of the amounts and locations of required force and moment unbalance corrections should be taken in one continuous operation without stopping the machine.

The amount-of-unbalance indicator should give readings which are proportional to unbalance. Also, the indicator readings should vary by less than one-quarter of the mean reading of the allowable residual unbalance. The amount-of-unbalance measuring device should show at least ⅛ in. of displacement for the measurement of an allowable residual-force unbalance of ...... oz.-in. and an allowable residual-moment unbalance of ... oz.-in. in each of two planes which are spaced ...... in. apart.

A lightweight wheel in which unbalances may be introduced in planes A and *B*, which are one-eighth as far apart as the bearings, should be mounted on the overhanging shaft of the intermediate size test rotor, as seen in Fig. 2. A workpiece may be used for these tests, if available. The machine should be set up to indicate directly the amount and location of force correction required in plane A (nearest the bearings) and the amount and location of equal corrections, spaced 180 deg. apart, in each of the two planes A and *B*.

The following test may be made with the machine adjusted to any desired sensitivity. Correction is made for unbalance in the test rotor until the application of additional correction does not further reduce the unbalance indication. In the plane A of the balanced rotor, an unbalance force equal to $2U$ is then introduced. The unbalance indicator should move at least ¼ in. to measure this "force" unbalance. Next, in the plane A of the balanced rotor, an unbalance equal to 20U is introduced. The moment unbalance in-

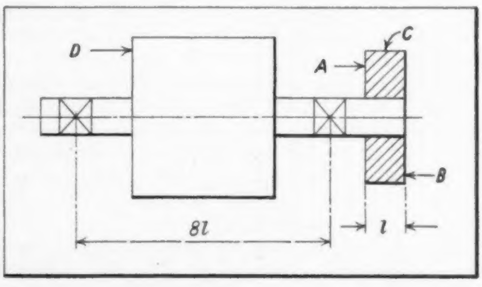


Fig. 2. Set-up for Testing for Separate Indication of Force and Moment Unbalance. Unbalances may be Introduced in the Planes *A* and *B* of a Lightweight Wheel *C* Mounted on the Shaft of a Test Rotor *D* of Intermediate Size

dication should then be less than U. Finally, a $20U$ moment unbalance is placed in the plane A of an otherwise balanced rotor, and a $20U$ moment unbalance in the plane B accurately at 180 deg. to that in plane A. The resulting force unbalance indication should be less than U.

With certain types of parts, in which the mass distribution is greatly different from that of a conventional rotor, it is difficult to reduce the vibration at the bearings to acceptable values. One such part is shown in Fig. 3. The planes of correction are close together as compared with the supporting bearings. Both correction planes are towards the same end of the work with respect to the centre of gravity, and both are overhanging. If U_L is, the only unbalance in the part (while it is rotated in freely supported bearings), the bearing axis of the part will generate cones bounded by the lines L-L and L^1-L^1. Similarly, if the only unbalance in the part is U_R, the bearing axis will generate cones bounded by the lines r-r and r^1-r^1.

It will be evident that there is little difference in the movement of the supporting bearings for a given unbalance in either the left-hand or the right-hand plane. Consequently, it is difficult, with any of the plane-separating devices described in the previous article, to obtain a suitable order of unbalance measuring accuracy for the left- and right-hand planes of such a part.

This problem can be resolved by measuring unbalance in force and moment values. The effectiveness of this procedure will be appreciated if reference is made to Fig. 4. If U_F, in the force correction plane, is the only unbalance in the rotating part, the bearing axis of the freely supported part will generate cones bounded by the lines f-f and f^1-f^1. Moreover, if the equal unbalances U_M are placed 180 deg. apart in the L and R planes of the otherwise balanced part, the bearing axis, when the part is freely supported, will generate cones bounded by the lines m-m and m^1-m^1. It will be apparent that bearing movements when using the force set-up differ greatly from those obtained when the moment set-up is employed.

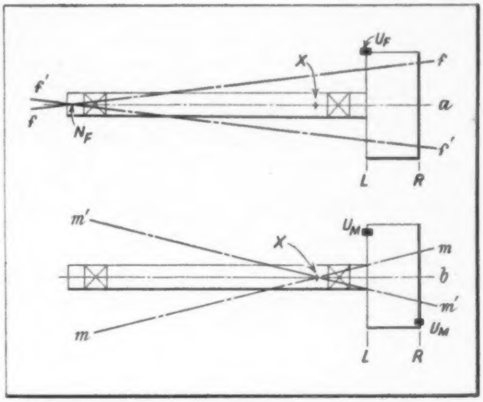


Fig. 4. Bearing Movements Differ Considerably when Unbalance is Measured in Force Values, as Seen in the Upper Diagram, and in Moment Values (Lower Diagram). The Centre of Gravity is Indicated at *X*

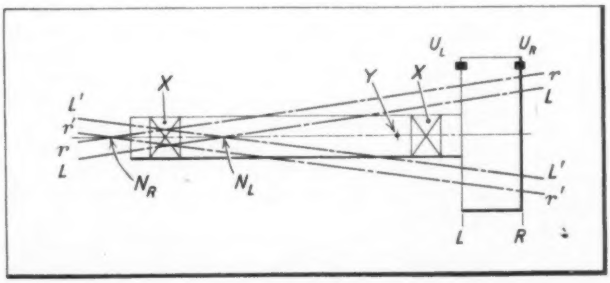


Fig. 3. Due to the Mass Distribution, it is Difficult to Reduce the Vibration at the Supporting Bearings *X* of this Part Unless the Unbalance is Measured in Force and Moment Values (Fig. 4). The Planes of Correction are Indicated at *L* and *R* and the Centre of the Gravity at *Y*

PRACTICAL CORRECTION UNITS

The balancing machine should incorporate adjustable means whereby the unbalance measuring device may be calibrated to show the required correction in terms of the correction units which are actually being used. In testing for correction units, the smallest test rotor should be placed in the machine. The rotor is then balanced with the machine at maximum sensitivity and an unbalance equal to $20U$ is introduced in the right-hand correction plane. With the test rotor running, and the balancing machine set to indicate unbalance in the right-hand plane, the unbalance measuring device is calibrated to read exactly 20. Next, the unbalance measuring device is calibrated to read exactly 13 for the $20U$ unbalance. This procedure is repeated to cause the unbalance measuring device to read any other number between 5 and 20, and for eight other arbitrarily selected num-

bers between 5 and 20. The entire operation is then again carried out with the largest test rotor.

If the balancing machine indicates the amount of unbalance in gm.-cm., oz.-in., or some arbitrary unit, the operator must convert this measurement into terms of the correction to be applied to the work. For instance, it may be necessary to determine the depth of drilled hole, grammes of weight to be added, length of wire solder, or number of correction washers to be attached. The conversion of the machine measurement to practical correction units can be accomplished with the aid of a "calibration constant"—a number whereby the machine indication is multiplied to determine the amount of correction units to be applied.

TABLE 1. DEPTHS OF HOLES TO BE DRILLED FOR VARIOUS AMOUNTS OF UNBALANCE

Amount of unbalance, oz.-in.	Depth to be drilled, in thirty-seconds of an inch, with a $\frac{1}{2}$-in. diameter drill. Depth measured from drill point (ground to 31 deg.)*	
	One hole	Two holes
0·2	6	
0·4	8	
0·6	11−	
0·8	13	
1·0	16−	
1·2	17	
1·4	18+	
1·6	20	
1·8	22−	
2·0	23	
2·2	25−	
2·4	26+	
2·6	28	
2·8	30	
3·0	31+	
3·2	33−	
3·4	34+	
3·6	36	
3·8	38−	
4·0	39+	
4·2	41	
4·4	43−	
4·6	44+	
4·8	45+	
5·0	47	
5·2	49−	
5·4		29+
5·6		30
5·8		31−
6·0		31+
6·2		32
6·4		33−
6·6		34
6·8		34+
7·0		35+
7·2		36
7·4		37
7·6		38−
7·8		38+
8·0		39+
8·2		40
8·4		41
8·6		42
8·8		43−
9·0		43+
9·2		44+
9·4		45
9·6		45+
9·8		46
10·0		47

* Holes are drilled at $4\frac{3}{8}$-in. radius. Plus or minus signs indicate $\frac{1}{64}$ in. above or below the depth given. Maximum depth $1\frac{1}{2}$ in. Drill through $3\frac{3}{8}$ in. thick steel plate and into lead counterweight.

Calculation by the operator may be avoided by providing a correction chart, an example of which is shown in Table 1. It will be apparent, however, that the increments must be fairly large if the chart is to be of practical size. Machine operators frequently prefer to apply correction by trial-and-error rather than employ a calibration constant or chart for accurate determination of the amount of correction required, but production suffers when it depends on trial-and-error skill.

After adjustment for a particular workpiece, the amount of correction required can be shown directly on the balancing machine amount-dial in terms of the means which are actually being used, for instance, the number of sixty-fourths of an inch for the depth of selected hole size, the number of eights of an inch of wire solder, or the number of washers.

SPEED OF ROTATION OF WORKPIECE DURING BALANCING

A specification for the workpiece speed during balancing may be omitted if only one type of part is to be balanced on the machine. If more than one type of workpiece is to be handled, it should be specified that the balancing machine should be capable of measuring and locating unbalance with the work rotating at a speed of . . . . r.p.m. or at any speed between . . . . and . . . r.p.m. The selected speed for balancing within this range should be obtained by changing the driving pulleys, or adjusting a potentiometer which varies the speed of the motor.

To test the machine for workpiece speed, it should be set up with the largest test rotor and arranged for rotation at the maximum balancing speed given in the specification. Also, it should be set up so that unbalance can be measured and located in accordance with the preceding specifications. Next, it is necessary to observe and record the steps and equipment required to measure and locate unbalance in the smallest test rotor to satisfy the preceding specifications, when the test rotor is running at the lowest speed given in the specification.

For each set-up, the machine should be arranged to satisfy the specification for accurate amount indications previously discussed. The change-over time will comprise three major items which should be carefully and separately determined. They are as follows:

1. The time required to arrange for driving the work at a different rotational speed, namely, the

time for changing belts and pulleys, adjusting and noting the workpiece speed, or adjusting machine elements (such as filter or springs), the setting of which varies with the rotational speed of the work.

2. The time required to adjust the machine elements to accept another size part, namely, the time required to adjust the carriages, to adjust or change the bearings, or to arrange for drive of the workpiece.

3. The time required to adjust the machine elements to give the desired readings of amount and location of unbalance. It may be necessary, for example, to adjust for plane separation, accurate angular indication, or practical correction units. The time should be determined on the basis that the part to be balanced has never before been set up, and that the machine is being re-set for a type of workpiece previously handled.

A part which is a rigid body is in balance at all rotational speeds if it is accurately balanced to any one speed. Although no rotating part is rigid in the strict sense of the word, many parts are sufficiently rigid for all practical purposes at speeds up to that of normal operation. Such parts should be balanced at the lowest speed which enables the required accuracy of balance to be obtained. The use of the lowest possible balancing speed reduces to a minimum the time required to bring the work up to speed and the time required to stop it after unbalance measurements have been taken. In this way, production is increased.

Parts which are not truly rigid bodies at their normal running speeds must be balanced at such speeds that each will be of the shape that it assumes in normal operation. This requirement may necessitate the use of a wide variety of speeds for different parts while unbalance is being measured and located. If a single balancing speed suffices, a squirrel-cage induction motor can be employed for driving the work. Such a motor, and the associated controls, are the least expensive on the basis of initial cost and maintenance, and where they can be used the cost of a balancing machine is reduced.

When it is necessary to provide a wide range of speeds to permit of balancing different types of workpieces, the required speeds may be obtained by using a squirrel-cage induction motor and a variety of pulleys. This arrangement helps to reduce the initial cost of the balancing machine, but the number of pulleys required for a variety of work, and the change-over time involved, may make it advisable to provide a variable-speed motor drive. The latter has a relatively high initial cost but may be a good investment if frequent change-over is required.

SPECIFICATIONS FOR DRIVING MOTORS

In specifying the driving motor for a balancing machine, the following items are important. The driving motor should be designed for operation from a power supply of . . . . volts . . . . phase . . . . , cycles, and be capable of bringing a part weighing . . . . lb. with a polar moment of inertia of . . . . ft. lb. squared, up to a balancing speed of . . . . r.p.m. in . . . . sec.; running the part at the balancing speed for 30 sec. with a windage and friction load of . . . . h.p. and stopping the part in . . . . sec. After a rest period of one minute, the motor should be capable of repeating this cycle. Also, the motor and control should (or should not) conform to JIC specifications, and should have a constant (or variable) speed.

To ensure conformity with specifications, the motor and control data plates should be inspected. It is desirable, where practical, that an actual sample of the workpiece should be available for this test. If a test rotor must be used, the windage and friction h.p. may be established by adding suitable fan-like members, as seen in Fig. 5, until the required h.p. to drive the rotor at the balancing speed is reached. The time required to start and

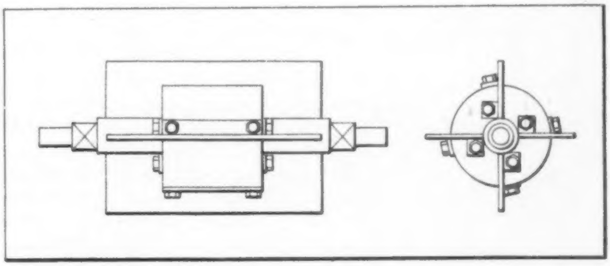


Fig. 5. When Checking the Performance of a Balancing Machine Driving Motor with a Test Rotor, Windage and Friction Horse-power can be Determined by Adding Fan-like Members

stop the workpiece should be checked with a stop watch while the two complete duty cycles required are being performed.

Few machines make such severe requirements on the driving motor and control as does a balancing machine. The duty cycle consists of bringing the workpiece up to balancing speed, running it at balancing speed for the few seconds required to measure and locate the unbalance, and then bringing it to rest. This duty cycle may be repeated by the operator under actual shop conditions after an intervals of a minute or less if the unbalance indications are accidentally lost or destroyed. For this reason, the specification should be arranged to take account of practical shop conditions.

The first part of the duty cycle cannot generally be met by a squirrel-cage induction motor if the accelerating time is in excess of 10 sec. and the motor is plugged to give a stopping time of substantially the same duration. Wound-rotor motors and controls, which are more expensive, may be used if the acceleration time exceeds 10 sec. Still more expensive direct-current drives may be necessary if the wound-rotor motor will not meet the duty cycle.

The second part of the duty cycle will often established the required h.p. of the driving motor if the windage h.p. is large, as in the case of large fans or blowers. In other instances, the load imposed by acceleration and stopping establishes motor size. The third part of the duty cycle may or may not impose a load on the motor. If the motor is not used to bring the workpiece to rest quickly, the duty cycle is substantially eased, and a smaller motor and control will often suffice. This reduced initial investment, however, is obtained only at the expense of higher costs for every part produced, unless adequate braking is otherwise provided. Where such provision is made, there will be little, if any, saving in initial investment.

INSTALLATION AND SERVICE REQUIREMENTS

The suppliers of the balancing machine should provide facilities for making all performance tests in the presence of the buyer's representative, prior to delivery. They should also provide a service engineer to install the machine, and to instruct operating and maintenance employees for a period of five consecutive days. The service engineer should be available within 48 hours after a request has been made.

Only a limited number, if any, of the operators and maintenance engineers in factories understand balancing machines and procedures. There should, therefore, be a broad dissemination of information on the balancing machine and procedures if maximum return is to be obtained from the investment in such a machine.

TABLE 2. METHOD OF TABULATING READINGS TAKEN DURING A PERFORMANCE TEST OF A SINGLE-PLANE BALANCING MACHINE

Column Number			
1	2	3	4
No. of *U* Units of Unbalance	Reading of Unbalance Measuring Device	Ratio of Unbalance Measurement Reading to Number of *U* Units	Permissible Deviation of Col. 3 from Average of Col. 3, Per cent
2			12½
5			5
10			2½
20			1¼
Total	...		...
Average	...		...

FLOOR-TO-FLOOR AND SET-UP TIMES

Suggested specifications for set-up and production times should include the following points. The floor-to-floor time for measuring and locating unbalance in each of two planes in practical correction units in part No. . . . . should be . . . . sec. The time required for setting up, for part No. . . . . for the first time should be . . . . min. The time required to repeat the set-up for part No. . . . . should be . . . . min.

The parts used for this specification should differ from each other as much as possible in weight, size, distance between bearings, size of bearings, and other features. If specific workpieces are not available, the smallest and largest test rotors should be used. The total time required to load the smallest rotor into the balancing machine should be observed and recorded. Unbalance in each of two planes (in practical correction units) should then be measured and located, and the part unloaded.

The floor-to-floor time for these tests should not exceed that specified. It is also necessary to observe and record the total time required to set up the balancing machine to measure (in practical correction units) and locate the unbalance in two planes, selected by the inspector, for the largest rotor. Finally, the time required to return the balancing machine to the set-up for the smallest rotor should be observed and recorded.

SINGLE-PLANE BALANCING MACHINES

Disc-shaped parts can frequently be balanced satisfactorily by applying a single correction. Generally speaking, rotating type " static " balancing machines are needed to meet today's requirement for accuracy. The following specifications and performance tests are recommended as a basis on which to purchase such equipment.

The balancing machine should indicate directly the amount and location of the single correction required to give balance. The amount-of-unbalance indicator should have at least ⅛-in. displacement for an allowable residual unbalance in the workpiece which will cause a vibration of 0·000050 in. of its axis. Two solid steel test discs, each with a thickness equal to one-fifth its diameter, should be provided. One test disc should weigh within 10 per cent of the minimum for which the machine was purchased. The other test disc should weigh within 5 per cent of the maximum.

Determine the oz.-in. of allowable residual unbalance in each of the test discs from the formula:

$$U = 16\ Wd$$

where U = allowable residual unbalance, in oz.-in., W = weight of the test disc in lb., and d = balancing accuracy in terms of in, of allowable vibration—or 0·00005 in. for the suggested specification.

Provide unbalances for each test disc equal to 2, 5, 10, and $20 \times U$. The weight required to introduce a given unbalance at a given radius may be determined by using the following formula:

$$w = U/r$$

where w = weight of the required unbalance, in oz., U = unbalance in oz.-in. and r = radius (in.) at which the weight will be added.

The smallest test disc is balanced as accurately as possible, at the lowest balancing speed for which the machine is supplied. Unbalances of 2, 5, 10, and $20 \times U$ are then added in succession and the readings of the unbalance measuring device are observed. The results should be recorded as indicated in Table 2.

The figures for column 3 of Table 2 are obtained by dividing the results in column 2 by the corresponding values in column 1. The total for column 3 is then determined and the average value is obtained by dividing the total by 4. The values in column 3 should not deviate from the average by more than the percentages shown in column 4. The average of the ratio column 3 should correspond with an unbalance indicator reading which represents more than ½ in. of unbalance indicator movement.

The balancing machine should accurately locate the point at which the correction for balance should be made. Unbalance location should be read on a continuous scale and it should not be necessary for the operator to change scale for specific values of unbalance location. Indications of unbalance location should be stable. Next, the smallest test disc should be balanced as accurately as possible, and unbalances of 2, 5, 10 and $20 \times U$, should be introduced and the results recorded as indicated in Table 3. These results must be within the acceptable values.

RESPONSE TO EXTRANEOUS VIBRATION

The balancing machine should be suitable for mounting directly on a floor, without requiring a special foundation or vibration-isolating devices. Equivalent displacement effect on the amount-of-unbalance measuring device should not be more than 15 per cent of the amplitude of either, or both the horizontal and vertical floor vibrations.

For this test, the machine should be mounted on a shaker table capable of producing total displacements of 0·003 in. at the balancing speed

TABLE 3. FORM USED TO RECORD DATA WHEN BALANCING THE SMALLEST TEST DISC

Number of U Units of Unbalance	Actual Location, deg.	Machine Reading, deg.	Machine Error, deg.	Acceptable Error, deg.	Instability of Reading, deg.	Permissible Instability, deg.
2	0			15		7½
5	0			6		3
10	0			3		1½
20	0			1½		1
2	180			15		7½
5	180			6		3
10	180			3		1½
20	180			1½		1

specified. The lowest balancing speed should be selected if a range of speeds is specified. The displacements should be produced in two directions 90 deg. apart, and at the same distance from the rotational axis of the test disc. Both displacements may occur simultaneously without detriment to the test, or they may be imparted separately.

If a shaker table is not available, the machine may be mounted on the test platform described in the previous article. When the test platform is used, two series of tests should be made. For the first series, the machine base can be in any position with respect to the exciter shaft, but the centre of mass of the machine should be approximately above the mid-point of the platform. The second series of tests should be made with the machine base turned through 90 deg. about a vertical axis from its position on the platform for the first series. Vibration of the shaker table should be checked in the manner previously described.

With an unbalance equal to $10U$ in the smallest test disc, the balancing machine should be operated so as to give unbalance indicator readings of the same value as were recorded in Table 2. Without stopping the balancing machine, the shaker table platform is vibrated at the above displacements, and the unbalance readings are noted. These readings are substituted in the following formula:

$$5555\ U/W\ (M_2/M_1 - 1) = \text{response factor}$$

where U = allowable residual unbalance of the workpiece being considered, in oz.-in., W = the weight of the workpiece, in lb., M_1 = the unbalance indicator reading noted without the shaker table operating; and M_2 = the unbalance indicator reading noted with the shaker table operating.

To satisfy the specification, the response factor for the unbalance indicator readings obtained should be 1·0 or less. This test should be repeated for both vertical and horizontal vibration displacements if the shaker table provides these vibrations separately. Also it should be repeated with the balancing machine turned through 90 deg. on the shaker table.

The surfaces of the balancing machine spindle on which the workpiece is located should introduce negligible unbalance effects because of run-out with respect to the spindle bearings. With the balancing machine at its most sensitive position, the largest test disc should be balanced until there remains less than one-half the permissible residual unbalance. The test disc should then be removed from the spindle, and remounted accurately at 180 deg. from its previous position. When the machine is again run, the unbalance indication should not exceed $1\frac{1}{2} \times U$.

The balancing machine should, again, incorporate adjustable means whereby the unbalance measuring device may be calibrated to show the required correction in terms of the correction units which are actually being used. To test for this requirement, the procedure outlined under the heading "Practical Correction Units" should be followed.

The following information on the work to be done should be supplied as an integral and detailed part of a balancing machine specification.

1. A detailed, dimensioned drawing of the part in the condition in which it will be delivered to the balancing machine. This drawing should give maximum diameter of part, maximum length of part, and weight.
2. The drawing should show permissible places at which correction for balance may be applied and the proposed method of applying correction.
3. The drawing should show clearly the positions at which the part is supported by bearings or the surfaces whereby it is located in the final assembly. If the part is to be balanced on anti-friction bearings, the size and location of the bearings should be shown.
4. The normal operating speed or speed range of the part should be indicated.
5. If the part is not a rigid body under the normal operating conditions, the first and second critical speeds should be stated.
6. If the part has an irregular periphery, so that when rotating it causes appreciable movement of air, the horse-power required to drive it at a suggested balancing speed should be indicated.
7. Particulars of production required should be given. If the production is on a weekly, monthly, or annual basis, the total number of hours that the balancer will run per week, per month, or per year should be specified.
8. If the balancer must handle more than one type of part, the maximum and minimum size of batch should be stated.

REMOVAL OF AIR FROM "POTTING" COMPOUND. To eliminate porosity of plastics mixtures employed for "potting" electrical units, a vacuum mixing pot is employed at the Wichita works of the Boeing Airplane Co., U.S.A. Stirring is carried out by a propeller type agitator and it is stated that about $3\frac{1}{2}$ hours is required for the removal of air from a 2-gal. container of compound. After it has been mixed, the compound is drawn from the bottom of the container through plastics tubing. A catalyst is then added, and further controlled mixing takes place. Until required for use, the mixture is stored in polythene cartridges at -40 deg. C.

New Production Equipment

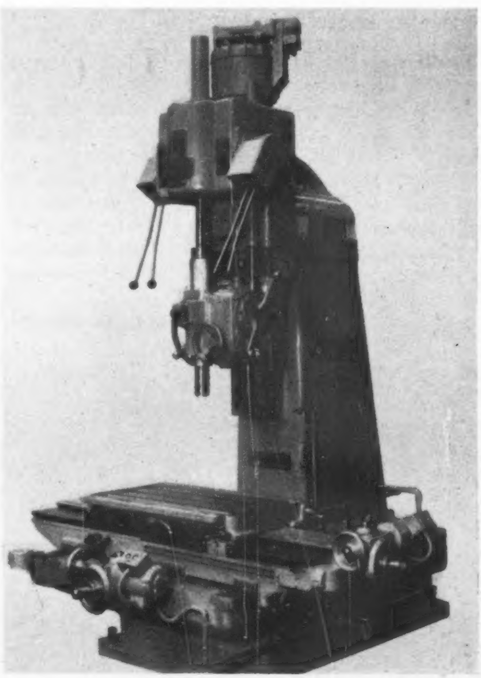
Kitchen & Wade Precision "Drill Borer"

The accompanying figure shows the precision "drill borer," recently developed by Kitchen & Wade, Ltd., Arundel Street, Halifax, for drilling, boring, tapping, facing and chamfering operations, with motorized table movements. It is designed to bridge the gap between the conventional vertical drilling machine and the toolroom jig borer, and eliminates the necessity for jigs or marking-out when work is being handled in medium batches. Holes can be drilled from the solid in cast iron up to 3½ in. diameter, and in mild steel up to 3 in. diameter, and the maximum tapping capacity for Whitworth threads is 2 in. diameter, and for gas threads 5 in. diameter. A substantial box-section column is bolted to a rigid baseplate. The former houses the electrical control gear and the latter incorporates a sump for a self-contained motor-driven coolant pump.

Vertical adjustment of 12 in. is provided for the spindle head on the square-section slideways on the front face of the column, and the head incorporates the main bearing for the spindle assembly. This bearing has a 12-in. long honed bore, and is provided with adjusting screws for taking up wear. A balance weight inside the column facilitates adjustment of the head by means of a handwheel on the left-hand side. There is a positive automatic trip for the feed, and a large-diameter graduated dial facilitates setting. Safety trips are fitted to limit the movement of the spindle in both directions. Rapid adjustment of the spindle is effected by means of the double levers, which also engage and disengage the feed, and there is a separate handwheel for fine hand feed.

Of 1¾ in. diameter at the driving portion, and multiple-splined, the spindle is enlarged at the nose end, which is bored No. 4 Morse taper as standard, or No. 5, for heavier duty. The spindle is mounted in precision-type, pre-loaded taper roller bearings, and further support is afforded by a hardened steel sleeve in which the feed rack is cut from the solid. A feed traverse of 11 in. is obtainable.

Drive is taken from a 5-h.p. constant-speed motor to a 12-speed gearbox mounted at the top of the column, which provides a standard range of 12 spindle speeds from 45 to 1,500 r.p.m. Alternatively, the spindle speeds may range from 36 to 1,200, or 27 to 900 r.p.m. There are nine rates of power feed, controlled by levers, which range from 0·002 to 0·020 in. per rev. of spindle. All the speed and feed gears are carried on multi-splined shafts which are ball-bearing mounted. Gearbox lubrication is provided by a built-in pump. A feed reverse lever enables the full range of feeds to be used either downwards or upwards. The main electrical control, which is mounted on the front



Kitchen & Wade Precision "Drill Borer"

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of the spindle head, gives forward, off, reverse, and "inch" for the spindle.

With a working surface of 36 by 20 in., the T-slotted table has 15 in. of in-and-out traverse and 30 in. of longitudinal traverse. Both the traverse motions are motorized and push-button controlled, and the operator can thus bring the table rapidly to an approximate position, after which fine adjustment is made by means of small handwheels. There are two index dials for each table movement, one dial reading in inches subdivided into tenths, and the other graduated in increments of 0·001 in. Where greater accuracy is required, provision is made for the use of measuring rods and dial indicators reading to 0·0005 in. The table is fully supported in its extreme positions, and narrow guideways and wide bearing surfaces are provided for both the table and slide.

The distance from the spindle centre line to the guideways on the column is 13½ in., and to the column, 18½ in., and the maximum and minimum distances from the spindle nose to the table are 26 and 3 in. Weighing approximately four tons, the machine is 10 ft. high, and occupies a floor space of 6 ft. 9 in. by 7 ft. 6 in.

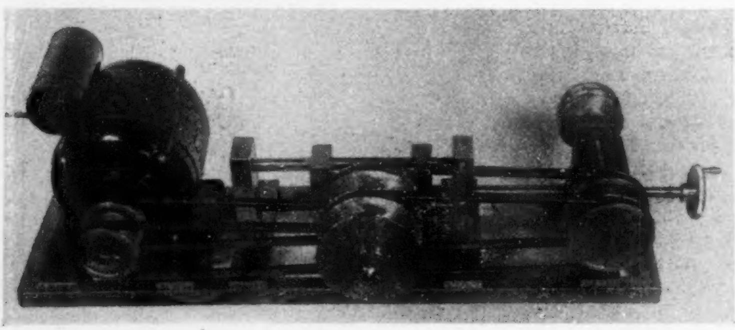
A Variable-speed V-belt Drive

The recently-introduced V-belt drive unit marketed by Philip de Havilland Machine Co., Ltd., 64-66 Grosvenor Street, Portsmouth, can be readily fitted to most types of machine and belt conveyors, for example. It is available with pulleys from 5 to 9 in. diameter, for use with from one to five pairs of V-belts of different cross-sectional sizes, depending upon the power to be transmitted. Speed ratios of 11·1 to 1 and 36 to 1 are obtainable with units which have 5- and 9-in. diameter pulleys, for instance.

A demonstration rig fitted with a drive unit for use with two pairs of V-belts is shown in the figure. Mounted between the motor and the driven spindle, the pulley assembly comprises fixed outer and sliding inner flanges which have interlocking slots so that a considerable range of axial adjustment, and, consequently, speed variation, can be obtained. The slots also ensure an improved grip between the belt and the flanges, so that the power transmission capacity is increased. The flanges are mounted on a sleeve which rotates on a fixed shaft, and the entire assembly is carried by a slide.

Speed adjustment is made, while the spindle is running, by movement of the slide towards or away from the driving motor, and due to the resulting variation in tension of the V-belts, the inner flanges are caused to move axially. In consequence, the effective diameter of two pairs of flanges is increased, and that of the other flanges is reduced.

Movement may be imparted to the slide by a screw, as shown, or, alternatively, by means of a lever. The lever arrangement enables spindle speeds to be quickly varied, and is usually fitted when the drive unit is employed on a drilling machine. The lever then passes through a slot in the belt guard, and apart from providing tapped holes in the spindle head for the attachment of guideways for the slide, and fitting single-groove pulleys on the spindle and motor shaft, no alterations are required. To prevent movement of the slide as a result of vibration while drilling is in progress, discs with serrated mating surfaces are attached to the lever and one of the guideways, and are held in contact with each other by spring pressure.

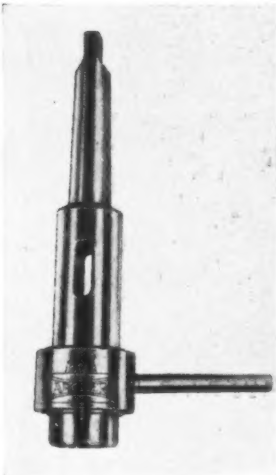


Demonstration Rig Incorporating a Multi-belt Variable-speed Drive Unit

Archer Coolant Adapters for Drill Chucks and Sleeves

Jacobs and "Marvel" drill chucks, and Archer sleeves, extension sockets, and turret sockets, made by Frank Guylee & Son, Ltd., Millhouses, Sheffield, 8, are now available with new, provisionally-patented, coolant adapters. An extension socket fitted with one of the adapters is shown in the figure.

These units are intended for use with "fluid feed" drills which permit coolant to be delivered directly to the drill point. Adapters can be supplied to take Jacobs and Marvel drill



An Archer Extension Drill Socket Incorporating the New Coolant Adapter

chucks from ¼ to ¾ in. capacity which have taper or threaded bores for mounting purposes. Combined safety and splash guards in transparent plastics are provided, and adapters with chromium - plated finish can be supplied for Jacobs chucks, if required, when water or some other corrosive fluid is to be used.

The drill sleeves are available in toughened or hardened steel with bores from No. 1 to No. 6 Morse taper, and external Morse tapers with tanged or threaded ends. If required, they can be supplied with internal and external Brown & Sharpe tapers. Also available in toughened or hardened steel, the extension sockets have Morse taper bores in sizes from No. 1 to No. 5 and Morse taper shanks from No. 1 to No. 6. Alternatively, sockets with parallel, and Brown & Sharpe or Jarno taper bores and shanks can be provided to order. The sockets can be supplied with cotter slots or threaded holes for draw bolts, in lengths up to 36 in. overall.

Turret sockets have shanks from ¾ to 3¼ in. diameter and bores from No. 1 to No. 5 Morse taper, but, if required, parallel and Brown & Sharpe taper bores can be provided. In addition, collet-type arbors for milling machines, fitted with coolant adapters are available, with No. 30, 40, and 50 International taper shanks.

F.R. Abrasive Discs and Cutting-off Wheels

Francis W. Birkett & Sons, Ltd., Cleckheaton, Yorks, are the selling agents in this country for the F.R. range of resin-nylon-bonded, flexible, depressed centre, grinding discs and cutting-off wheels, which are claimed to permit rapid grinding and cutting of metals, plastics, stone and concrete, and to have a high safety factor. The discs and wheels are particularly intended for use on high-speed portable hand grinders, surface grinders, and the various types of cutting-off machines.

One of the recent developments is a corrugated cup wheel, which is said to permit exceptionally cool grinding on all types of flat surfaces. It is made in coarse, medium and fine grades, and can be run at speeds up to 8,500 r.p.m. An additional grade of depressed centre grinding disc, known as the SAF, has also been introduced, for grinding and cutting stainless steel, at speeds up to 8,500 r.p.m. F.R. discs and wheels are available in a wide range of sizes and in various grades to suit different work materials.

Abrams Motor-driven Sheet Metal Rolling Mill

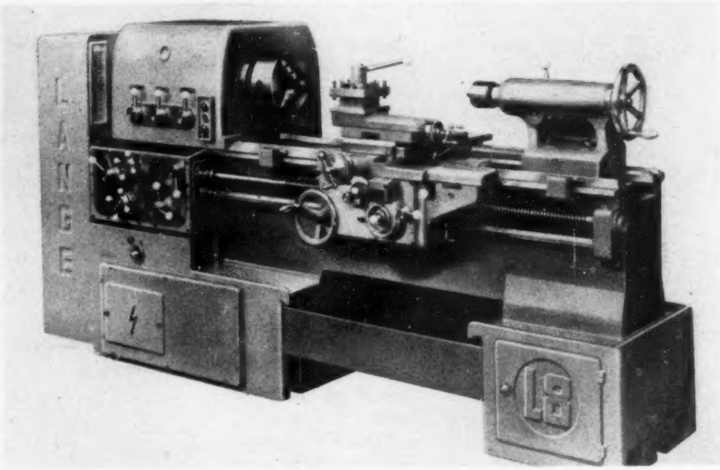
Abrams Engineering Syd Abrams, Ltd., Waterloo Road, Manchester, who for some time have built hand-powered rolling mills, have recently developed the motor-driven mill shown in the accompanying illustration. It is intended for rolling sheet metal, including electronics and precious metals, and lead strip.

The rolls, which are 4 in. diameter by 6 in. wide,

Abrams Motor-driven Sheet Metal Rolling Mill

are of high-grade alloy steel and heat-treated to provide for rolling a wide range of materials. They are mounted in 2-in. diameter plain phosphor-bronze bearings, and are individually driven by a patented worm and worm wheel arrangement, incorporating ball thrust washers. The worms are of high-carbon steel and the worm wheels of phosphor-bronze. A vertical adjustment of ⅞ in. is provided for the top roll, by a pilot wheel, worm gearing and vertical screws, and an index plate provides micrometer adjustment for thickness of sheet.

Housed in a fabricated steel base, a 3-h.p. reversing motor and a worm reduction gearbox provide the drive to the rolls. The rolling speed is determined by the material to be rolled, and is such as to ensure a high rate of production and at the same time permit ease of control. Occupying a floor space of 26 by 28 in., the machine has a total height of 56 in., and the approximate weight is 3 cwt.



Lange Type L8 High-speed Centre Lathe

Lange Type L8 High-speed Centre Lathe

The type L8 high-speed centre lathe shown in the figure is built by the German firm of G. & H. Lange, for whom Benrath Machine Tools, Ltd., Longley Lane, Wythenshawe, Manchester, 22, are the distributors in this country.

It is available in two basic sizes with swing capacities of 19¾ and 25⅝ in. over the bedways and 12 and 15¾ in. over the cross-slides, and work from 39 to 114 in. long can be accommodated between the centres, according to the length of the bed. If required, gap-type beds can be provided, and diameters up to 30 and 34 in. can then be turned for a maximum distance of 8⅝ in. in front of the faceplate. The 15¾-in. wide bed is strengthened by inverted U-shaped webs, which facilitate disposal of cuttings. Inverted V-shaped bedways are provided for the saddle, and the tailstock is guided by separate vee and flat ways.

Equipment, which is the subject of a patent application, may be incorporated in the apron for accurately controlling the travel of the carriage. With this arrangement, when two diameters are to be turned on the workpiece for similar or different lengths, the required travel for the first diameter is pre-set on an optical scale, and at the end of the cutting traverse the sliding feed is automatically disengaged. Upon completion of the cutting traverse for the second diameter, automatic disengagement of the sliding feed is effected by a stop attached to the bed.

The cross-slide is extended at the rear to take a hydraulic copying attachment which enables both profile turning and boring to be undertaken, and a 4-way or a quick-change toolpost may be mounted on the front top slide. Taper turning equipment, and a thread chasing attachment, which enables three different pitches to be cut with a single leadscrew and follower unit, can also be provided.

Steplessly-variable spindle speeds ranging from 22 to 2,000 r.p.m. are available, the drive being taken from a pole-changing 12-h.p. motor through a safety clutch to a P.I.V. variable speed gear housed in the base. For the higher speeds in the range, down to 143 r.p.m., the drive between the P.I.V. gear and the spindle is transmitted by a flat belt and pulleys which ensure vibration-free running. The lower spindle speeds are obtained through back-gearing in the headstock. If required, reduction gearing can be fitted which enables spindle speeds down to 1 r.p.m. to be obtained.

Adjustment of the P.I.V. gear is effected by a separate geared motor through a safety clutch. For rapid stopping of the headstock spindle, injection

braking is applied to the main driving motor. Starting, stopping and reversing of the spindle, also adjustment of spindle speeds, are controlled by push-buttons incorporated in an extension piece at the right-hand end of the apron. Notches are provided in this extension piece to facilitate selecting the push-buttons while the work is being observed. There is also a separate switch for selecting the motor speeds. A push-button is provided on the headstock for "inching" the spindle. Mounted in Timken taper roller bearings, the spindle is bored to pass a 2⅜-in. diameter bar, and will accommodate a No. 5 Morse taper shank.

The quick change feed gearbox enables 45 metric threads from 0·75 to 88 mm. pitch and 32 Whitworth threads from 22 to ¼ per in. to be cut without the use of pick off gears. By transposing slip gears, 33 threads from 0·75 to 22 module can be cut. Forty-five sliding and surfacing feeds, the former ranging from 0·002 to 0·049, and the latter from 0·0005 to 0·0165 in. per spindle revolution, are available.

Eclipse Type FP 186 Fine Pole Magnetic Chuck

The type FP 186, fine pole, non-electric, magnetic chuck, here shown, has recently been added to the Eclipse range made by James Neill & Co. (Sheffield), Ltd., Napier Street, Sheffield, 11, and is primarily intended for use on production grinding machines.

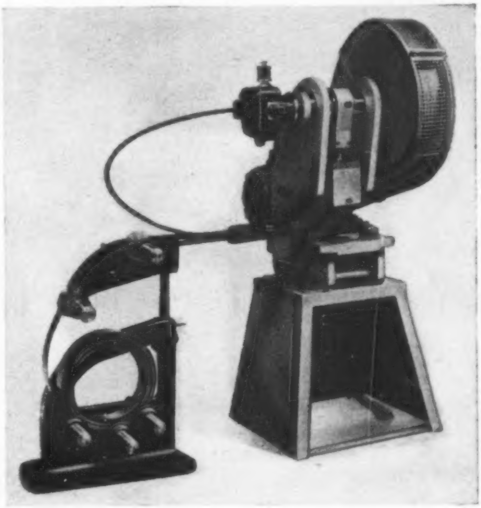
Of castellated form, the poles are closely spaced to permit parts which have small or large surface areas to be firmly held. The "outer" poles are connected to each other so that flux can be applied to a single workpiece located at any position on the 18- by 6-in. top surface. Whereas the entire surface of the chuck is energized, the main work-holding area does not include the edges, which are normally employed for packing strips.

The range is shortly to be extended to include fine pole chucks for mounting on 24- by 8-in. tables, also 10- and 12-in. wide tables of different lengths, in steps of 18 in.

Eclipse Type FP 186 Fine Pole Magnetic Chuck

Martyn 18-ton Press

The Martyn 18-ton press, recently placed on the market by Martin Poole, Ltd., 16-20 Wenham Street, Balsall Heath, Birmingham, 12, is here shown set up in conjunction with the Swift Feeder 3-in. stroke hydraulic strip feed unit, made by Birmingham Tool & Gauge Co., Ltd., Soho Hill, Birmingham, 19.



Martyn 18-ton Press

Available for bench mounting, or with a sheet metal base, as illustrated, this press can be supplied with ram travels of ½ and 1 in. Drive to the high-tensile steel crankshaft is taken from a 2½-h.p. motor through V-belts to the flywheel, and thence by a "banjo"-type clutch. The operating speed is usually 160 strokes per min., but the press can be supplied with other working speeds, to suit require-

ments. Fabricated from 1¼-in. thick, flame-cut steel plates, the frame carries a 1¾-in. thick bolster plate, with a working surface of 16 by 14 in.

Granville Type 9H Horizontal Bandsawing Machine

Recently introduced by F. Coals, Ltd., Woodford Avenue, Woodford Green, Essex, the Granville type 9H horizontal bandsawing machine, here shown, has a capacity for cutting steel bars up to 9 in. diameter, and will also handle tubes, angles and other sections. The work holding vice can be swivelled through angles up to 45 deg., and will accommodate sections up to 16 by 6 in. An attachment for setting the vice angle to within ¼ deg. is available.

Granville Type 9H Horizontal Bandsawing Machine

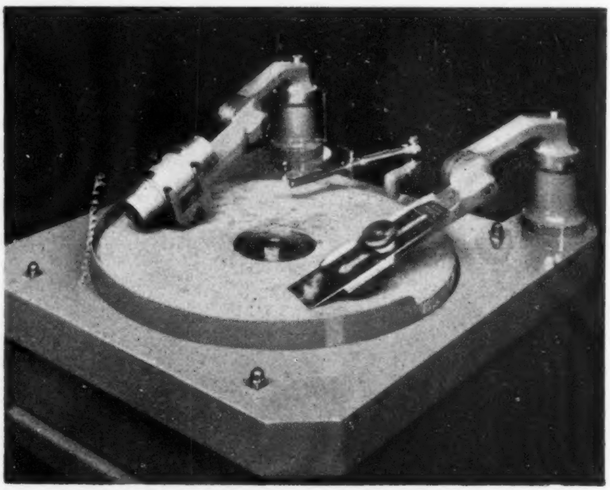
Drive is taken from a 1-h.p. motor, through heavy duty reduction gearing, and four saw speeds, namely 65, 130, 190 and 260 ft. per min., are obtainable. The machine will take 144-in. long by 1 in. by 0·035 in. thick saw blades, which can be supplied with various tooth pitches.

Pivoted in long-diameter needle roller bearings, the saw frame is counterbalanced by a coil spring, and a constant rate of down feed is applied positively by a self-contained hydraulic unit, which can be readily removed from the box-section base, if required, for maintenance purposes. The down feed can be steplessly varied to suit the cross-sectional area of the bar and the type of material being cut, by means of a knob on the hydraulic unit. At the end of the cutting stroke, the main driving motor is stopped by a micro-switch, and the arm can be rapidly raised by a hand-operated valve.

Viceroy Sharpedge 16-in. Edge Tool Sharpening Machine

Denford Small Tools (Brighouse), Ltd., Victoria Works, Birds Royd, Brighouse, have recently introduced the Viceroy Sharpedge 16-in. machine for sharpening plane irons, chisels and other edge tools. A close-up view of this machine is shown in the figure. It is fitted with a 16-in. diameter by 1¾-in. wide, grade A.180, abrasive wheel, which runs at 85 r.p.m., and is driven by a ¼-h.p. motor, through chain and sprocket wheels, enclosed in the fabricated steel cabinet. Oilite bearings are employed and lubricant is pump-fed to the wheel.

There are two swivel arms, fitted with attachments for carrying chisels up to 1¼ in. wide and plane irons up to 3 in. wide, and they can be adjusted through an angle of 15 deg. The total height of the machine is 36 in., the floor space required, 19 in. square, and the approximate weight, 1¾ cwt. A 5-amp. rotary switch provides for forward and reverse rotation of the wheel.



Close-up View of the Viceroy Sharpedge 16-in. Edge Tool Sharpening Machine

Examples of Tooling for the Derota Transfer Press

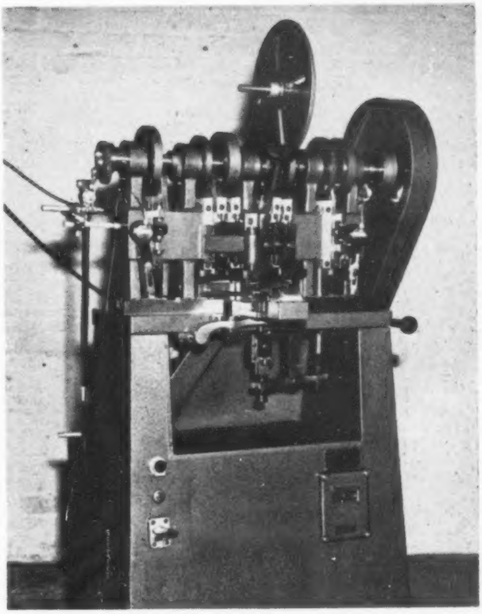


Fig. 1. Derota Type M Precision Transfer Press

In an article in MACHINERY (89/1203—23/11/56), reference was made to the Derota 3-ton transfer press manufactured and marketed by Platarg Manufacturing Co., Ltd., Shortlands, London, W.6. This press is, in effect, a combined blanking, piercing, forming and bending machine, suitable for producing a wide variety of components from strip or wire. The various rams are operated by track-type cams mounted on a single shaft, and maximum versatility is afforded by the provision of downward, horizontal, and upward ram motions. As each tool-holder is individually adjustable for stroke, it is seldom necessary to change the cams, and since the rams operate sequentially, the full 3-ton capacity can be utilized on each. Consequently, the effective tonnage is equivalent to that of a considerably larger single-ram machine, such as would be required for comparable follow-on tooling. Also, since the tooling is divided into separate units, it is of a simple, economical nature, and each unit is readily adjusted or replaced, without disturbing the settings at the other stations.

The latest version of the machine, shown in Fig. 1, incorporates a number of refinements, and is known as the type M. A centralized lubrication system is now provided, and the fly-wheel assembly has been redesigned to include a single-stroke clutch. The latter is housed within the V-belt drive pulley, which also serves as the flywheel. To facilitate changing the forming cams, the main shaft is in two sections, and the removal of the follower-rollers for servicing or replacement has been simplified. The rollers are of larger diameter, and the width of the cam tracks has been increased. A micro-switch cut-out for strip control, and a Schrader air ejection system, are fitted as standard, and electrical switchgear is of improved design.

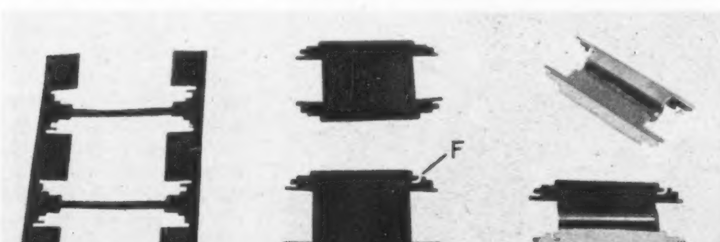


Fig. 2. Radio-valve Components of the Type Seen at the Right are Produced at the Rate of 100 per min. on a 3-ton Derota Transfer Press

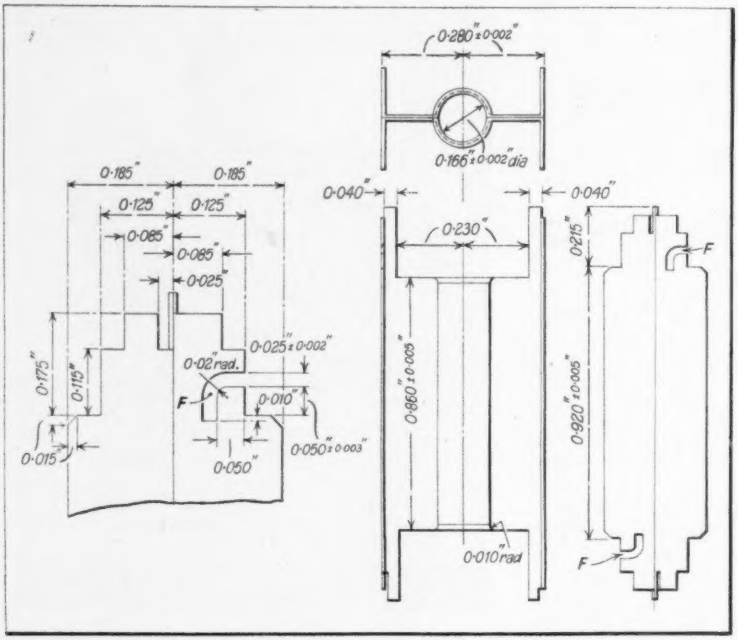


Fig. 3. Principal Dimensions and Tolerances on the Components Shown in Fig. 2

As blanking is usually the first operation, and transfer is effected by means of a feed blade with an accurately adjustable stroke, pilot holes in the strip are unnecessary, and the full strip width can be utilized. In this way, it is stated, material savings up to 25 per cent can be effected. As a typical example, tooling for the radio-valve component shown at the right in Fig. 2, will be considered. Two flat blanks are seen at the centre of the illustration, and a portion of the blanked strip at the left. The complete assembly comprises two such components joined together, back to back, as in Fig. 3, in which the principal dimensions and tolerances are indicated. Nickel strip, 1½ in. wide and 0·008 in. thick, and carbonized on one side, is employed. In the finished components, the carbonized surface is on the inside of the fluted channel section, to which the blanks are formed at the rate of 100 per min.

A view of the working zone of the machine is given in Fig. 4, and in Fig. 5 are shown the various elements of the tooling, removed from the machine, to enable details of the design to be observed. For convenience of reference, the elements are similar-

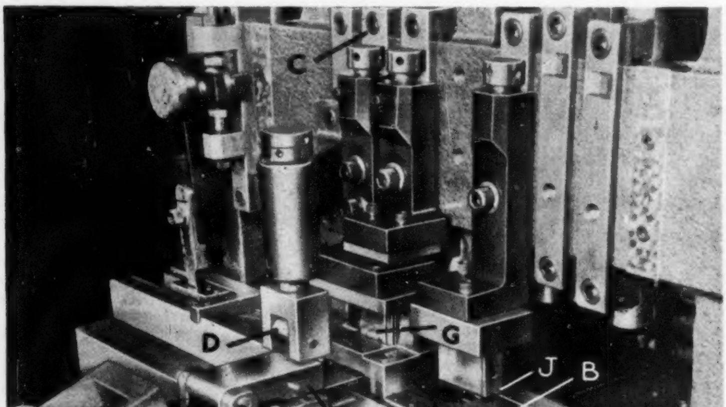


Fig. 4. Close-up View of the Working Zone of the Press, Showing Tooling for the Components in Fig. 2 and 3

ly annotated in both figures. Also seen in Fig. 5 are the holders whereby the tools are mounted on the rams. The strip is fed into the first-stage tool by the grip-feed unit *A*, at right-angles to the bed and the transfer blade *B*, and the stroke is controlled by an adjustable stop. In Fig. 4, it may be noted, the transfer blade is seen just short of the fully-advanced position, whereas, during the feed stroke, it is fully retracted to the left. The grip and release action of the feed unit is derived from the ram *C*, Fig. 4, on which is mounted the roller *D*.

The blanking and piercing tools at the first station are of a two-level design, whereby the blank is sheared from the strip, and carried downwards into the profiled aperture *E* in the transfer blade, by the continued descent of the blanking punch. With the blank thus accurately located, the small J-shaped notches *F*, in Fig. 2 and 3, are pierced by auxiliary punches arranged to slide in the main blanking punch *G*, Fig. 5 and 6. The latter illustration gives an enlarged view of the punch assembly, and the auxiliary punches are seen at *H*. Separate plates are provided for the main and auxiliary punches, whereby they are attached to two independent rams, so that one ram provides for blanking motion, and the other, for piercing. The two rams are operated by means of a single cam, which is provided with tracks on both sides.

On completion of the piercing stroke, the punches *G* and *H* are raised, and the transfer blade travels to the right, carrying the pierced blank to the next station *J*, Fig. 4 and 5. Here, mounted on the third ram, there is a form punch, which operates in conjunction with a compound lower tool. In the aperture of the latter, there is a bead portion, which is arranged to slide vertically, and is strongly spring loaded upwardly. This bead is surrounded by a stripper pad, which is also spring loaded, but less strongly than the bead. In the free position, the bead and stripper are level with the die-plate. The action of the tool is as follows.

During the initial part of the stroke, the blank is lightly gripped between the bottom face of the punch and the stripper, and the latter is pushed downwards, so that the flute is formed against the bead, by a corresponding portion of the punch. With continued descent, the bead and pad are pushed down together, and the edges of the blank are wrapped round the sides of the punch by the edges of the die aperture. At the bottom of the stroke, the moving elements of the die assembly engage fixed stops, so that the work is finally lightly "coined" to the finished form. On the up-stroke, the work is ejected from the die aperture by the action of the stripper, and after the piece has been stripped from the form punch by a pair of pins, it is blown clear by an air jet. The ejector-pins, and the air-valve controlling the jet, are actuated by the fourth ram. Once the formed com-

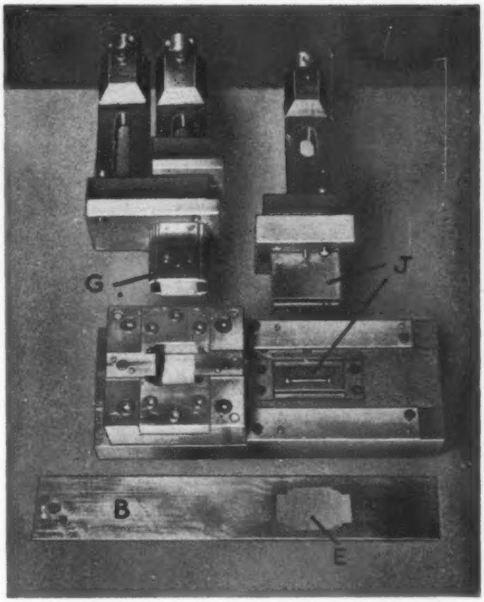


Fig. 5. Tooling and Tool-holders Removed from the Machine, to Show Details of the Design

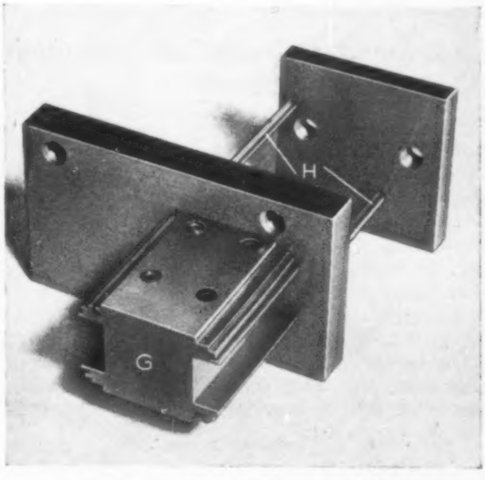


Fig. 6. A View of the First-stage Punch Assembly, which Comprises a Blanking Punch, and Auxiliary Piercing Punches

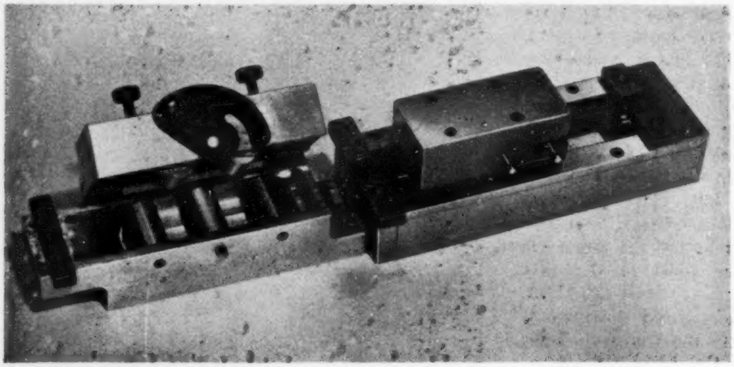


Fig. 7. This Recently-introduced Roll Straightening and Grip-feed Unit, Designed to Feed Laterally, Provides a 3-in. Feed Stroke for the 3-ton Machine, and a 5-in. Stroke for the 9-ton Size

ponent is clear of the die, the transfer plate returns to the first station, in readiness for the next cycle. The limits indicated in Fig. 3 are readily maintained.

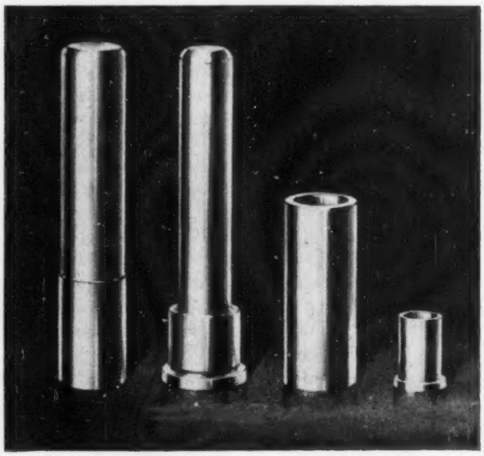
In order to increase the versatility of the machine, the company has recently introduced the combined roll straightener and feed unit shown in Fig. 7. This unit is designed for mounting on the left-hand end of the bed, so that the strip may be fed in a direction parallel with the transfer plate and bed, instead of at right-angles, as in the set-up described. In this instance, also, the opening and closing action of the gripper is derived from one of the rams, which is provided with a special extended roller support arm. The necessary reciprocating motion is obtained from the cam-actuated linkage which is normally employed to operate the left-hand transfer blade, and with this arrangement, a 3-in. feed-stroke can be obtained. With the first-mentioned feed attachment, the maximum stroke is 1¼ in.

The company has also recently introduced a 9-ton machine, similar in principle to the 3-ton press, which will accommodate a maximum strip width of 2½ in., and the feed-stroke is 2½ in., when a standard feed attachment is employed. By the use of the lateral feed attachment described, however, the maximum stroke can be increased to 5 in. The 9-ton machine has a variable speed drive from a 3-h.p. motor. For both sizes of machine, the transverse feed is available in the form of a complete attachment, comprising the straightener, feed-block, gripper, and cams. One cam provides for the reciprocating motion, and the other for gripping and releasing.

B.A.C. Standard Guide Pins and Bushes for Moulds

A new range of standardized guide pillars and bushes for injection and pressure moulds has been introduced by British Aero Components, Ltd., Montague Road, Warwick. These items, examples of which are shown in the figure, are made from special alloy steel and nitrided, and it is pointed out that this treatment is of particular advantage where they are required to operate at elevated temperatures. Hardness, it is stated, is retained indefinitely, up to 500 deg. C.

The mould bushes and pins, which supplement those previously supplied for die sets, are available in sizes from ⅜ to 1¼ in. diameter. Overall lengths of pins range from 1⅜ to 10 in., and of bushes, from 1¼ to 5¾ in.



Examples from the New Range of B.A.C. Standard Guide Pins and Bushes for Use in Conjunction with Injection and Pressure Moulds

Die Casting Supplement

The Ejection of Deeply-cored Die Castings

By H. K. and L. C. BARTON

The great majority of die casting dies now being constructed are either arranged for push-rod (or "bumper-bar") ejection, or for ejection by means of an independent hydraulic cylinder. Between them, these two methods probably account for more than 90 per cent of all the dies currently in operation, and this pre-eminence is solidly based upon their radical simplicity as regards both construction and operation. Nevertheless, problems in die design arise from time to time which either implicitly exclude, or at any rate reveal the shortcomings of, these standard methods of ejection. Such problems are commonly encountered, for example, when die castings must be produced from very deep cavities.

Push-rod ejection, as exemplified in the tool for which the sequence is depicted in Fig. 1, is by far the simplest method available to the designer. The moving die member is bored to provide housings for both the array of ejectors *E* and the large diameter return pins *R*, all of which are arranged to slide in the moving member, and are secured at the rear within the ejector-plate *A*. This latter is normally of composite construction, as in the example illustrated. The ejectors have enlarged heads to ensure retention, but are usually made a fairly easy fit in their seatings so that they can align themselves with their housings in the moving member even when its dimensions have changed slightly as a result of heating to operating temperature.

With this arrangement, the whole array of ejectors is moved bodily backwards, in relation to the moving die member, as the ends of the return pins contact the fixed member when the die is closing, and is moved forward again, towards the end of the opening stroke, when the plate *A* is arrested by the fixed push-rods *B*. These rods are attached to the machine frame and project through holes in the moving platen. It will be noted that the distance *x*—the clearance between the face of the fixed die member and the furthest projecting portion of the die casting—remains constant once the ejector-plate has contacted the push-rods, while the moving die member continues

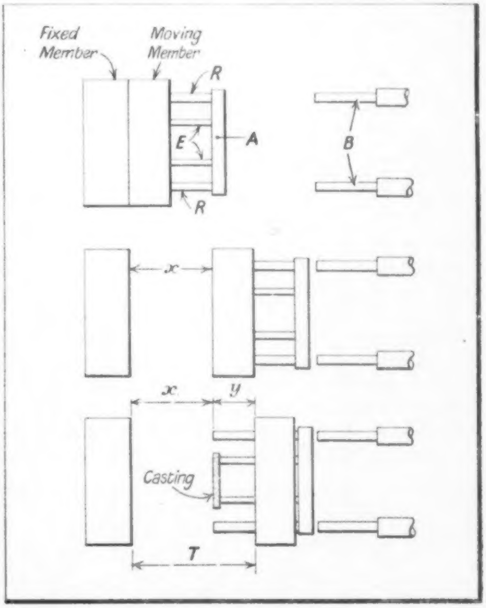


Fig. 1. The Normal Sequence for a Die with Push-rod Ejection is here shown Diagrammatically. The Casting Remains Stationary in Relation to the Machine After the Moving Member has been Traversed through the Distance *X*

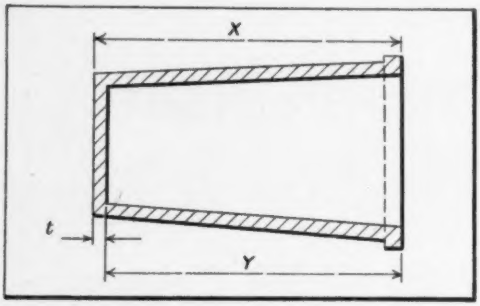


Fig. 2. The Required Minimum Die Opening Stroke for this Casting is a Distance *X* to Bring it Clear of the Cavity, Plus a Distance *Y* to push it Clear of the Core

to retract through a further distance shown at y.

This latter portion of the stroke is determined by reference to the clearance between the rear of the casting and the projecting core element of the moving member, which is necessary to permit unimpeded withdrawal of the component from the die space. Since on toggle-operated machines the total stroke is not variable, x can only be increased if y is diminished, and *vice*

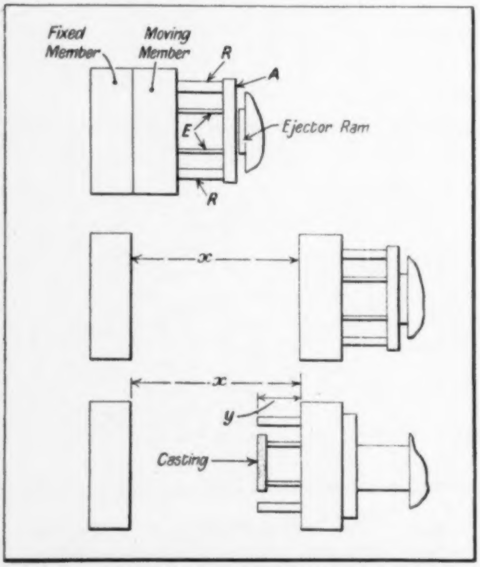


Fig. 3. Diagrams Showing the Sequence where Ejection is Effected by an Independent Ram

versa. Herein lies, in fact, the salient disadvantage of push-rod ejection, for, in practice, a die for which a large withdrawal stroke x is required also demands a large ejection stroke y. This requirement necessarily follows from the fact that a die casting of any great depth usually has the form of a thin-walled dish or cup. Consequently, the external and internal dimensions X and Y, Fig. 2, are likely to differ by only 0·050 in. or 0·060 in.—the thickness of the end wall—and this amount is negligible in comparison with the dimensions X and Y.

The required total stroke for a tool to pro-

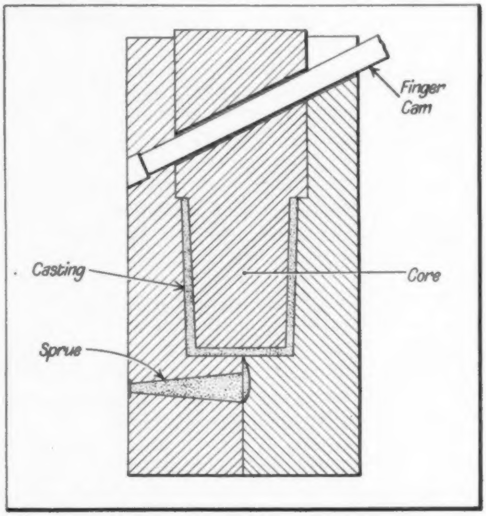


Fig. 4. A Typical Die Lay-out with a Moving Core Arranged for Finger-cam Withdrawal

duce a casting of the type depicted is thus, at the very minimum, a distance X plus Y. In practice, however, it is preferably a little in excess of $2X$, to provide a workable clearance. In other words, the greatest possible value for X is a little less than half the total die stroke T, Fig. 1. This restriction also applies to tools in which ejection is effected by an independent ram, since although the moving platen is completely retracted prior to ejection, as indicated in Fig. 3, the final position of the casting in relation to the two die blocks is exactly the same as with push-rod ejection.

To permit production of deeply-cored castings, where X is greater than $T/2$, it is usual to split the cavity between the die members and to fit a massive moving core actuated by a hydraulic

cylinder or (as in Fig. 4) by finger cams. For a component in any specific size range, a die of this sort is, of course, a little slower in operation than a simple two-part tool for producing a comparable casting, but if the casting is of such a depth as to preclude the use of the latter, this objection is not really tenable. A more serious drawback, in many instances, is the lower dimensional accuracy associated with the tool seen in Fig. 4, as against the designs in Fig. 1 and 3.

Where the whole external form of a component is produced in one die member, the other merely carrying a core element, the only dimension subject to appreciable variation is the end-wall thickness, the actual value of which in any particular casting depends on the effectiveness of die closure when the shot was made. Thus, a heavy flash is associated with a thick end wall and a light flash with a more normal value. Seldom in practice, however, is the dimension across an end wall highly critical, and the thickness of the side walls is subject only to minor variation, provided that the tool has effective registration surfaces.

This last generalization only fails to apply when, as may very occasionally happen, the die is closed on a large particle of metal debris in such a way as to hold the blocks apart on one side—usually the feed side. If the gap amounts to as much as, say, 0·010-in., the effect is to tilt a deep core quite appreciably in the cavity in the manner shown, greatly exaggerated, in Fig. 5. As may be seen, the result is to vary the wall thickness between points near the closed end, and points near the open end, of the component. Castings with such variations are unlikely to reach the customer, since the metal cut-out through the gap is likely to reduce injection pressure so much as to cause unsoundness and poor finish.

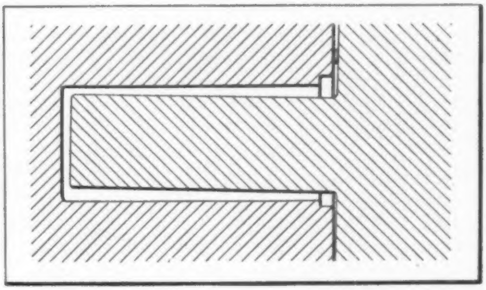


Fig. 5. With a deep Cavity, Incorrect Closure may Result in the Core being Tilted, as Shown

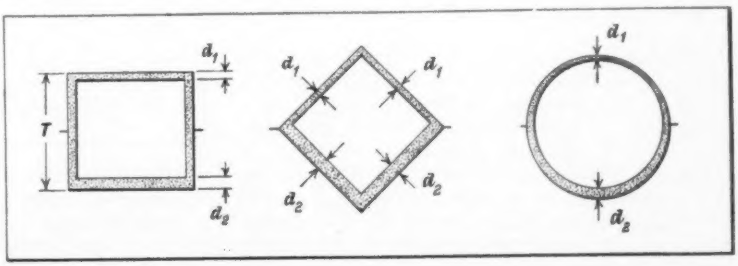
WALL THICKNESS VARIATION

Castings produced from a tool like that shown in Fig. 4 are likely to have appreciable variation in end-wall thickness, since the core cannot always be prevented from moving back under the thrust of the molten metal. In addition, there may well be considerable variations in side-wall thickness, sometimes of a rather complex character. These variations can be shown most clearly by taking a component of square section as an example, and examining the cross-sections illustrated in Fig. 6.

The section on the left is characteristic of the most usual disposition of the cavity, where it is split evenly between the two die members with the parting-plane arranged at right angles to the side walls.

In this instance, any variation in flash thickness, due to imperfect closure, primarily affects the overall width T across the die parting. With a heavy flash, the external dimension T may thus be increased by, perhaps, 0·006 in. or 0·008 in., but there is, of course, no corresponding increase in the internal dimension determined by the moving core. The whole increase is accordingly accounted for by a thickening of the opposed walls, as indicated at d_1 and d_2. If the core could float freely, the increment would be equally divided between these two dimensions, but since, in general, a core slides within a housing attached to the moving die member only, it is usual to find that the greater part of the thickening occurs at the side of the part formed by the stationary die block.

Fig. 6. Core Float Results in Wall Thickness Variations from d_1 (thinnest) to d_2



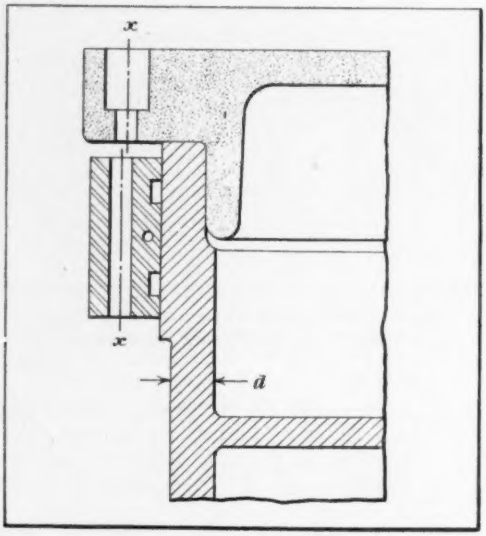


Fig. 7. Variations in Wall Thickness *d* make it Difficult to Maintain Alignment of the Hole Axes *x-x*

With a square-section cavity sunk in the manner indicated on the left, the disparity between the wall thicknesses is most marked, but it is also present in the centre sketch, where a square cavity is diagonally disposed, and in the circular section on the right. For many applications, such a variation in wall thickness—within the limits likely to be encountered in good die casting practice—does not raise any real problem, but occasionally one comes across assemblies where difficulties of alignment and registration arise. When examined, these difficulties invariably prove to have resulted from an attempt to achieve dual registration in the mating component, whether it is another die casting or, as it has occasionally been, a plastics moulding.

DIFFICULTIES ASSOCIATED WITH DUAL REGISTRATION

The two sketches in Fig. 7 and 8 will, no doubt, make this point clear. In Fig. 7 is shown part of the side wall of a die cast housing with which a moulded cover is assembled. The primary registration—indeed, the only registration of the two major components of the assembly—depends on the engagement of a projecting portion of the moulding with the inside face of the die casting. Since the size of the cored recess in the casting is substantially invariable, and the mating portion of the moulding can be held to very close limits, it is easy to achieve a good fit, free from play in any direction, between the two components.

There is, however, another requirement, since it is sought, in addition, to align two elements of a sub-assembly which are separately located upon the outer face of the casting and within a recess in the moulding, as shown. These small components cannot, however, be registered with any high degree of accuracy, since the position of the moulding varies with the float of the core, whereas the lower element of the sub-assembly is mounted on the outside face of the die-casting. Any variation in wall thickness d is thus reflected in a shift of the nominally coincident axes at $x-x$.

The same effect, in reverse, is depicted in Fig. 8, where the moulding is located by the outside of the casting and satisfactory primary registration is provided. Here, secondary registration is represented by the desired coincidence of the axes of the long steel insert, located by the core of the die casting, and the cored boss in the moulding. Again, it is impracticable to attempt dual registration, since the steel insert necessarily reflects the float of the core, and so cannot be accurately aligned with the bore of the boss. It will be noted, however, that in this instance the difficulty could be entirely obviated by locating the moulding from the inner wall of the component. The outer overhang could still be retained, but a small clearance would be provided, as in the modification seen on the right of the figure.

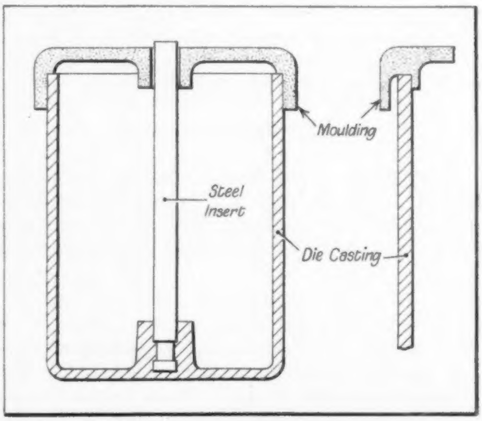


Fig. 8. Location of the Moulding from the Outside of the Casting is Not so Effective as Location from the Inside of the Latter, as Shown in the Part-sectional View at the Right

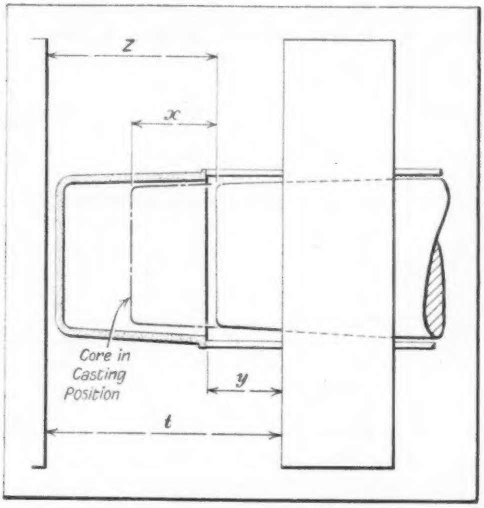


Fig. 9. A Die with a Core which is Retractable in the Direction of Carriage Travel

USE OF CORE WHICH SLIDES IN THE DIRECTION OF DIE TRAVEL

It is assumed, of course, that in both the examples cited the depth of the casting is too great to allow the use of a simple two-part die with the cavity sunk wholly in the fixed member—the arrangement which permitted the closest control over dimensional variation. There are, however, several ways of overcoming this difficulty that do not involve splitting the cavity between the two die halves. The simplest, where a machine of adequate capacity is available, is probably that indicated in Fig. 9, where the core is made retractable in the direction of die travel.

This method increases the maximum depth of component, for a given opening stroke, by nearly 100 per cent, if the core is fully retracted, as in the figure. The required ejector stroke then need be only sufficient to clear the sprue of the distributor pin in the case of a "goose-neck" machine and can be even less for a cold-chamber die where the slug, as a rule, has little depth of engagement with the face of the tool. There is, however, no particular advantage in retracting the core completely unless the depth of the casting makes such retraction essential. It is only necessary to draw back the core until the clearance Z (Fig. 9) is a little greater than the ove:all depth of the component.

The construction and operation of a tool of this type are both facilitated when a machine fitted with an independent ejector ram in the moving platen is available. This ram can then be used to operate the core while ejection is performed by a conventional plate actuated by push-rods. A section through such a tool is shown in Fig. 10. The core *C*, which is arranged to slide in the moving die member, projects from the rear of the latter when in the casting position. To permit passage of the core, the ejector plate *A* is cut away, the clearance between the two being kept to a minimum so that ejectors *E* can be brought to bear on the casting without difficulty. At the rear of the core is attached a plate *K*, the main purpose of which is to house a set of guide bushes whereby alignment is maintained. These bushes, as indicated in the figure, are engaged with four register pins *G*, seated in the rear of the die block. The pins pass through the plate *A*, and clearance holes for the bushes are provided at these points.

The core-plate *K* is secured to the hydraulic ejector ram by means of a split bushing, the stroke of the ram being sufficient to advance the core until, in the casting position, the plate *K* is in contact with the plate *A*. Return pins *R*, which are in contact with the face of the fixed member when the tool is closed, determine the position of the plate *A*. As will be evident, with this arrangement the stroke of the plate *K* may precede or follow (or even be coincident with) the stroke of the plate *A*, as circumstances may indicate. In general, however, it is desirable to withdraw the core before advancing the ejectors, since the strain on the latter is then reduced. The operating

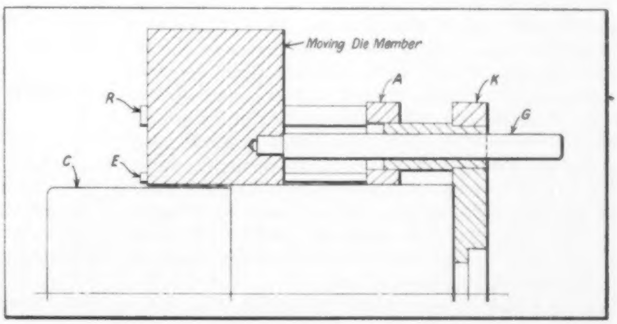


Fig. 10. A Sectional View of a Tool with a Retractable Core

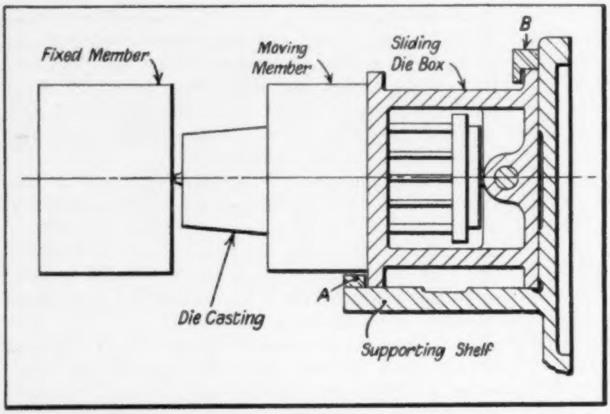


Fig. 11. A Vertical Section Through a Tool which is Arranged to Slide Laterally

cycle, therefore, is usually set so that the core begins to move back as soon as the casting has been freed sufficiently to avoid risk of sticking in the fixed member. Movement may be started well in advance of the point at which the component actually clears the fixed member, and the ejectors come into action as soon as the casting is completely clear. The moving die member thereafter continues to retract until the casting is also clear of the core, and it can then be drawn laterally from the die.

From the standpoint of dimensional consistency, this method is superior to that of Fig. 4 (both because the cavity is not split and because the core is more rigidly guided) but the castings are slightly less accurate than those produced in a simple two-part die with a fixed core. For this reason, some die casters have preferred, in such circumstances, to retain the fixed core, and to displace the whole or a major portion of one of the die members in order to provide space for unimpeded ejection of the component. For simplicity of operation, it is preferable to arrange for the ejector half of the tool, rather than the cavity half, to be displaced.

Displacement can be effected vertically or horizontally. For the former, the mechanism adopted is usually such that the die block is moved automatically at a pre-determined point in the casting cycle, but horizontal displacement of the block is preferred when the movement is to be effected manually. For this latter method, the actual construction of the tool does not differ from that of a normal two-part die with rack-and-pinion ejection, but the ejector box is arranged to slide sideways on a base-plate fitted with rails or keyways. This base-plate is rigidly secured to the moving platen.

Such a tool is seen in section in Fig. 11. This particular design was chosen for purposes of illustration because it is superior to many as regards the support provided for the moving member—or rather for the ejector box upon which the moving member is mounted. The base-plate consists of an L-section casting with a shelf-like portion upon which the ejector-box (also of cast iron) rides. A flat steel rail *A*, adjustable to take up play, retains the box on the shelf, and a second rail or guide *B* provides a way for the top flange of the box. As will be evident, the shelf must considerably exceed the die box in length, to ensure that the latter is adequately supported when drawn out of line with the fixed die half.

In operation, metal is injected and the die opened in the usual manner. At the end of the opening stroke, the operator pulls the whole moving die assembly sideways until the casting is quite clear of the fixed member, as shown schematically in Fig. 12. The casting is then ejected by means of the rack-and-pinion mechanism and can be removed from the die. In order to reduce the effort needed to start ejection, which may be very considerable for deep-cored castings like those under review, some of these tools incorporate devices which eject the casting through a short distance—⅛ in. to ¼ in.—before or during the sideways movement. An independent ram, axially mounted in the platen, may be employed to initiate ejection. Alternatively, small cam surfaces may be provided on the base casting, which come into operation near the end of the lateral stroke. The inertia of the heavy die assembly is then utilized to jerk the casting free from the core, prior to ejection proper.

SAFETY ARRANGEMENT FOR DIES WITH LATERAL MOVEMENT

It is, of course, important, with all tools of this type, where part of the assembly is moved out of line with the remainder at some point in the cycle, to attach limit switches to the two ends of the slideway and link them to the control system in such a way that the cycle is positively arrested while the sliding member is displaced. In other

words, it should only be possible to re-start the cycle when the "casting position" switch is actuated and the "ejector position" switch is released. One sometimes sees a control of this type installed in such a manner that the failure of either of the switches could conceivably result in the cycle being resumed while the sliding block was in transit between the two positions.

This risk is always present where the switches are arranged in the manner shown schematically in the upper view in Fig. 13. Here the "ejector position" switch is not actuated until the block reaches the end of its travel. A preferable arrangement (for manual ejection) is indicated in the lower sketch. Here, a roller contact switch is actuated as soon as the die is moved slightly from

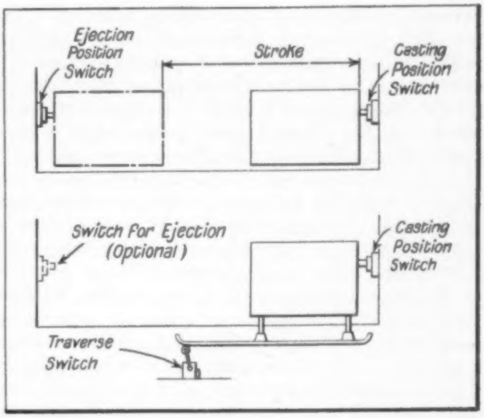


Fig. 13. For Safety, the Limit Switches Should be Arranged as Shown in the Lower Sketch. When Disposed as Indicated in the Upper Sketch they Cannot be Relied upon to "Fail Safe"

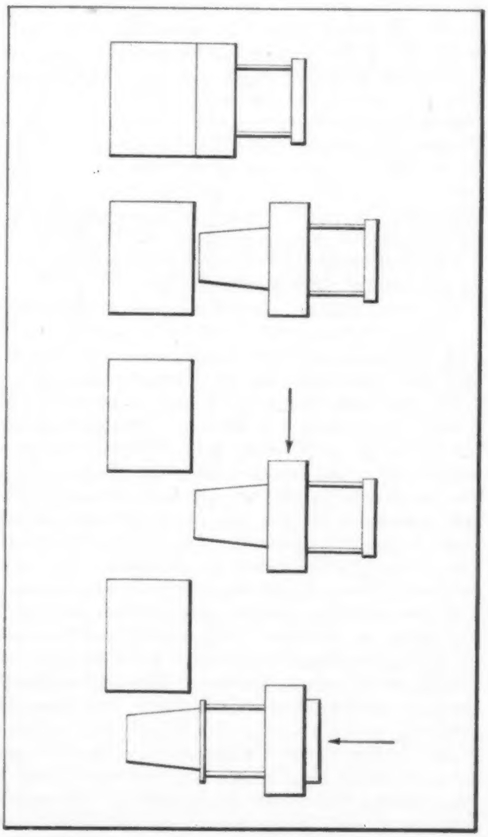


Fig. 12. Sequence of Operations for a Tool in which the Moving Member is Displaced Laterally Prior to Ejection

the casting position and remains operative throughout the travel. If the ejector stroke is to be effected automatically, however, a third switch is needed at the end of the slideway to initiate the movement of the ejector plate.

Conventional means of actuating the ejectors cannot normally be employed when the moving member is shifted some distance off centre prior to ejection. Push-rods, for example, can seldom be effectively applied unless the resistance to ejection is so well balanced over the die area that a single pair of rods (instead of the usual four) suffices. A thrust plate can sometimes be mounted on the ends of the push-rods to increase the area of abutment on the ejector plate. On an automatic machine, the adoption of this method necessitates arresting the cycle just before the push-rods are brought into action. The moving member is then slid sideways and ejection takes place. This method should only be used when lateral movement of the die member can also be carried out automatically, otherwise there is a serious risk of injury to the operator or damage to the die.

This danger exists even if safety switches, on the lines briefly discussed above, are fitted to the tool. If the sliding part of the die is drawn back by hand, and at the end of the stroke contacts a switch to initiate ejection, the platen begins to move while the operator is still gripping a part of the die. This practice should not be permitted in any circumstances.

There are, it is true, several ways of making provision for the operator to move clear of the

die after displacing the sliding portion. The simplest is to incorporate a foot switch in series with the limit switch, and to place the former so that it can be depressed only after the hand-grip on the sliding block has been released. On some machines, the control gear enables the "ejector position" limit switch to be used to actuate a delay, pre-set to four or five seconds, instead of directly initiating the ejector stroke. Nevertheless, it is highly desirable that manual reciprocation of the sliding block should be avoided when the remainder of the cycle is automatic.

On many machines, it is practicable to fit a small-diameter, long-stroke, hydraulic cylinder to reciprocate the moving die-block, and the whole sequence, with the exception of charging and injecting metal, is then part of a timed cycle, the movement of the platen being arrested while the die-block moves laterally into line with the off-centre ejector-pad or thrust-plate. At the end of this movement, the platen is retracted completely, thus ejecting the casting, and there is a brief dwell to allow the operator to remove the casting from the die-space.

Where a fully-automatic rack-and-pinion ejector-box (such as was supplied with some Lester machines a year or two after the war) can be made available, this class of tool is much easier to operate. The type of ejector box required contains a normal thrust-plate with combined guide-rods and racks, each pair of which meshes with a short pinion. A longer vertical rack also meshes with the pinions, and at its upper end projects from the box. Here, it is coupled to the ram of a hydraulic cylinder, which is operated "in cycle" as if it were a core-pulling cylinder.

Although for general purposes this arrangement is inferior to normal push-rod ejection, since there is a tendency for the casting to stick if resistance is intermittently increased (for example, by flash penetrating the ejector housings as the tool gets hot), it is of considerable value when the whole moving die assembly must be displaced during the cycle. When the complete box is mounted in the manner indicated in Fig. 11, it can be moved, either manually or automatically, at an appropriate point in the cycle. As most hydraulic machines have provision for at least two auxiliary cylinders, one can be used for the ejection mechanism and the other for the traverse.

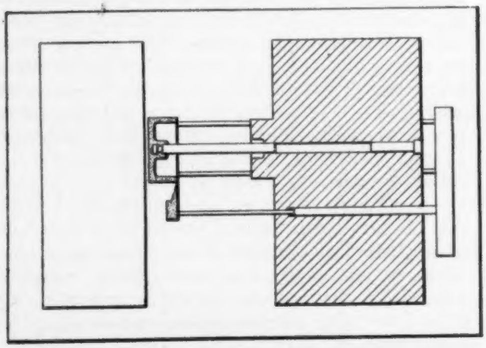


Fig. 14. With Long Inserts, Ejection of the Casting is Often Difficult

EJECTION DIFFICULTIES ASSOCIATED WITH LONG INSERTS

As a rule, trouble due to interference between casting and die at the end of the ejector stroke occurs with parts of the general form indicated in Fig. 2, which involve an unusually deep cavity in the fixed die member. Occasionally, however, it is depth of engagement with the moving member that causes the difficulty, and this is almost always attributable to the combination of a hollow-backed die casting and a long insert as indicated in Fig. 14. The shape of the die casting being such that it is desirable to produce it in a two-part die with the insert housed in the moving block parallel to the axis of ejection, the length of the insert then results in the casting fouling the cavity at the end of the ejection stroke.

In some instances, the actual ejection stroke may be short (for example, if the insert is shouldered), and the difficulty then lies in the fact that the spray of castings cannot be drawn far enough forward, after ejection, to enable the operator to tilt it free and withdraw it laterally. Where it would be definitely impossible to withdraw the component from an orthodox die, the design of the tool must necessarily be modified, but it is still not uncommon to see dies in operation in which there is just bare space for the operator, by tilting and twisting the spray, to withdraw the components. Tools of this type are troublesome, slow, and dangerous to operate. It is perhaps inevitable that the use of very long inserts should result in slow operation, but there is no reason why it should not be easy—and reasonably safe—to place them in position and subsequently withdraw the castings.

Any of the types of tools so far described can be used where long inserts are involved as well as for castings formed in deep cavities. However, there are simpler methods that can often be adopted when the only difficulty is concerned with the withdrawal—and perhaps the loading—of long inserts. Much depends upon the number and spacing of the inserts, for although they may be

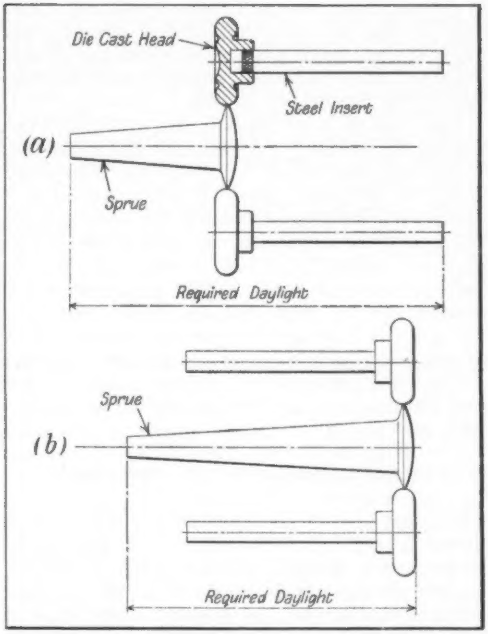


Fig. 15. Alternative Methods of Orientating Sprays of Castings Incorporating Long Steel Inserts

positioned one at a time, by hand, which enables them to be tilted in various ways, they can only be ejected as a rigid spray which offers less scope for displacement.

Insert loaders cannot be used in such circumstances, for if the inserts are so long as to cause difficulties at ejection, it is hardly likely to be possible to slide the charged loader between the die members. Limitation on insert length is most noticeable with dies for centre-gated gooseneck machines, since the sprue-metal projects well in front of the spray of castings, as indicated at *a* in Fig. 15, even if the cover die—the fixed member—is relatively thin. It is surprising how rarely one sees this difficulty overcome in what is surely the simplest and most obvious manner—at least for a multi-cavity tool for small and fairly simple castings. The overall length of the spray is much reduced by using a deep fixed block to house the inserts, and a thin ejector block. In this way, the orientation of the spray is reversed, as shown at *b* in the figure.

There is, of course, a tendency for a casting orientated in this manner to stick in the fixed die as the tool opens, but this is by no means a major difficulty, and it can always be overcome by modifying draft and, if necessary, by providing anchoring lugs that will hold the casting securely to the moving member during the opening stroke. The runner channels, too, should be cut wholly in the moving member and should have minimum draft. Additional heat transfer to the cavity half of the tool is thus insured, and anchorage is improved. Ejection from such a tool may be quite conventional. Indeed, despite the length of the inserts only a very short ejector stroke is needed. Extra ejectors should nevertheless be arranged to bear on the runners and anchoring lugs, in order to spread the thrust evenly.

The arrangement indicated at *b* in Fig. 15 is clearly only suitable for components of simple form. Opportunities for drawing lateral cores, for example, are very limited in a tool with the cavities disposed as shown. The advantages of locating the inserts in this manner are very great, however, and tools of a more complex character may well be justified when the die cast head of a composite part incorporates features that cannot be obtained easily in a two-part die.

DIE WITH SLIDING BLOCKS FOR CASTINGS WITH LONG INSERTS

In Fig. 16, for example, undercuts in the sides of the component necessitate moving cores. Consequently, the cavities are arranged in a single

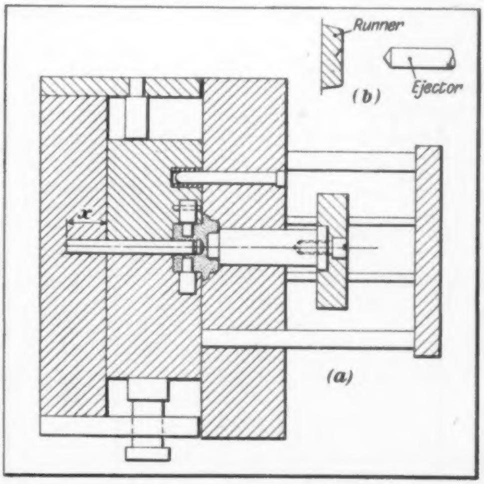


Fig. 16. The Insert is here Located Between Sliding Blocks. After Withdrawal Through a Distance *x*, the Spray of Castings can be Removed Sideways Between the Faces of the Slides

row, and the inserts are housed in the fixed die member. The major portions of the cavities are formed in sliding blocks at the top and bottom, which are actuated by hydraulic cylinders (not shown). In the moving member are mounted short cores which form the recesses in the heads of the castings. Although these cores are not retractable, they are so mounted that they can slide in the die block and are attached to a rigid plate at the rear.

This plate is fitted with return pins, which force it back against stops when the die closes. The ends of the return pins bear upon the sliding blocks in this instance, although it is occasionally desirable to locate them along the joint-line of these blocks, in such a way that they pass between them to contact the stationary block. In the die shown, this construction would have impeded ejection of the spray. It will be noted that the sliding blocks are not housed in the fixed member, but slide on the face of it. They are retained and guided by large-diameter rods held in overhanging plates attached to the top and bottom of the die-block.

In operation, a set of inserts is located in the fixed member, which is provided with shallow seatings into which they fit easily. The sliding blocks are then brought together, gripping the inserts securely, and the moving die member is advanced. As the tool closes, the core plate and the ejector plate are both pushed back into the casting position and dowels projecting from the moving member enter bushes in the faces of the sliding blocks,

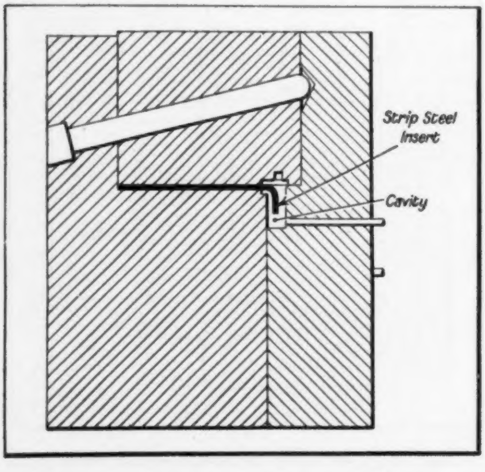


Fig. 17. Location of a Flat Insert Beneath a Sliding Block

to prevent them from moving back under the pressure of the injected metal. After injection, the die is opened about ¾ in. to withdraw the dowels, the small cores remaining engaged with the castings as the die member moves.

The sliding core blocks are next retracted, leaving the castings supported on the quasi-fixed cores, with the forward ends of the inserts still seated in the fixed block. Further retraction of the moving member withdraws the castings from the fixed die half, and at the end of the stroke, push-rods actuate the ejector plate to strip the castings from the cores. The ejectors move forward freely for some distance before contacting the spray, and bosses are provided on the runner to ensure an adequate bearing area for each pin. At the ends, the pins are slightly coned, so that they tend to re-centre themselves as the ejector-plate is operated.

DIE FOR CASTINGS WITH FLAT STRIP INSERTS

In some tools for castings with inserts of considerable length, it is helpful to form part of the insert housing in a sliding block. Such an arrangement is often desirable when the insert is of non-circular section, and particularly when it is of flat strip form. In general, tools for inserts of this type are designed on the lines indicated in Fig. 17, and it will be seen that the construction is relatively simple. The insert is located on a shoulder of the fixed die member or even on the top face of the block, and the latter is grooved so that sideways movement is prevented. A heavy overhanging core-slide, mounted on the moving member, forms the upper part of the insert seating, and no elaborate locking mechanisms are necessary since there is very little thrust against the underside of the sliding block.

The cavity is sunk mainly in the moving die member, although there is no restriction upon part of it being cut in the fixed member, should the form of the component require. It is not possible, however, without adopting a rather more complex design of tool, to form any portion of the cavity in the rear of the sliding block. If the latter has a simple up-and-down movement, as in this instance, any part of the component cast within the rear face would be sheared on the upward stroke.

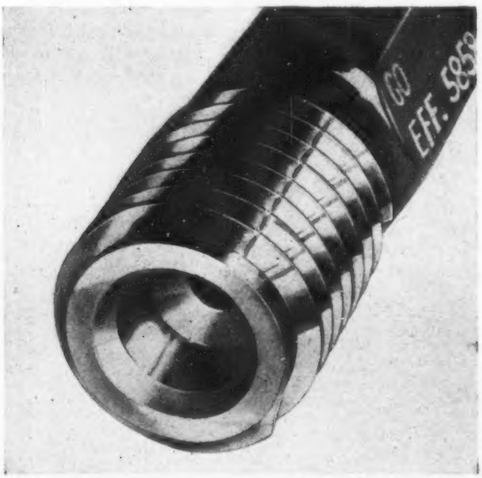
Provision must be made for withdrawing the block through a sufficient distance to enable the spray of castings to be lifted clear of the upper face of the fixed member, for removal laterally from the die. It is, of course, assumed that a tool of this type would only be adopted when the inserts would still foul the fixed member at the end of the ejector stroke. In the example here illustrated, the

insert lies in a plane at right angles to the die parting, but similar tools have been successfully operated with the main part of the insert at some other angle to the parting. In such circumstances, a service hole in the insert may be desirable in order to prevent it from sliding forward before the die closes. In Fig. 17 only a single insert is shown, but it should be noted that tools of this type are hardly ever justified unless of multi-cavity form. It is usually possible, with a single cavity, to orientate the insert so that it lies mainly or wholly in the die parting, and so does not present any real ejection problem.

E.S.T. Multi-Life Screw Plug Gauges

Engineers' Special Tools, Ltd., Catteshall Lane, Godalming, Surrey, who are makers of plug gauges in steel, Nitralloy and tungsten carbide, recently extended their range to include screw plug gauges of the design shown in the accompanying figure which is the subject of patent application 19839/58.

Known as the E.S.T. Multi-Life, this new gauge is provided with a recessed end, and there is a centre hole at the bottom of the recess. When required, the hollow portion can be faced back by grinding in order to remove the leading end of the thread when it has become worn or damaged. The chamfer at the start of the thread is then



End view of a Multi-Life screw plug gauge of the type that has recently been introduced by Engineers' Special Tools, Ltd.

reground. This recovery process, it is claimed, may be repeated as many as four times, depending on the pitch of the thread and the extent of wear. Up to eight threads, in all, can be removed from a fine-pitch Multi-Life screw plug gauge before it must be discarded.

A special department has been established, in which Multi-Life gauges are produced on Matrix thread grinding machines, and subsequently restored.

This type of gauge can be supplied in sizes ranging from 4 B.A. to 2½ in., and with British, Unified, American, or Metric thread forms. If required, a hard chromium surface may be provided at extra cost.

Under existing arrangements, we are informed, these gauges are restored for further service at one-third of their original cost, and are returned to the user within one week.

New Portable Laboratory Cold Flask. It is reported in the July issue of the *A.S.T.M. Bulletin* that, to provide for testing liquefied gas fuels at temperatures of the order of -270 deg. F., a new portable laboratory test cold flask has been developed which may be connected to any suitable test chamber. The unit employs liquid nitrogen at -320 deg. F., in conjunction with a heat exchanger, and the duration of the test is limited to 12 hours.

There are four heat exchanger tubes immersed in the liquid nitrogen, and air, cooled by these tubes, is passed into the test chamber and thence back to the heat exchanger in a continuously re-circulating cycle. The temperature in the test chamber is indicated by a thermocouple, and an associated potentiometer, and is controlled by two dampers which regulate the flow of the re-circulating air. Tests showed that the unit could lower the temperature in the test chamber to -267 deg. F.

The liquid nitrogen is normally consumed at an average rate of 25 litres per hour, but by exercising careful control over the level of the nitrogen in the flask this figure can be reduced to 20 litres per hour. It is suggested that in future designs of low-temperature heat exchangers, plate-type liquid nitrogen evaporators may be incorporated in the test chambers.

Mechanically-propelled Works Trucks of the Fork-lift Type produced during the second quarter of this year reached a total of 893. For comparison, the corresponding figure for the same quarter of the previous year was 1,094.

Denham 20¾-in. Centre Lathe for Profiling Marine Diesel Engine Piston Heads

A 20¾-in. centre heavy-duty profiling lathe, which was recently supplied by Denham's Engineering Co., Ltd., Halifax, to Swan, Hunter, & Wigham Richardson, Ltd., Newcastle-upon-Tyne, for internal copying operations on piston heads for Doxford marine diesel engines, in a range of sizes from 600 to 750 mm. (23·622 to 29·528 in.) nominal, is shown in Fig. 1 set up for demonstration and acceptance tests.

The substantial bed has chutes at the rear to facilitate the removal of cuttings, and "sunk" and flat guideways for the saddle. Drive is taken from a 30-h.p. screen-protected reversing motor, controlled by a star-delta starter, through a multi-disc clutch and hardened steel gears, which give 18 spindle speeds ranging from 6 to 304 r.p.m. An ammeter is mounted on top of the headstock, and the driving motor incorporates a "plug" type electrical braking system. Mounted at the rear of the bed are enclosed busbars and collector gear, and a travelling contactor panel, for the rapid traverse drive to the saddle at the rate of 1 in. per sec. Push-buttons for starting, stopping and reversing the spindle and rapid traverse drives are mounted on the headstock, apron, and a pendant control unit. The headstock spindle runs in specially-paired ball and roller bearings.

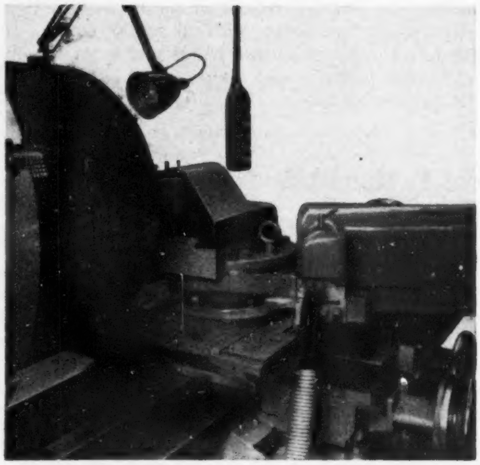


Fig. 2. Close-up view of the hydraulic copying slide on the Denham profiling lathe

Fifty-four feeds ranging from 0·002 to 0·125 in. per spindle rev. are obtainable, and there is a single lever on the apron for selecting the sliding and surfacing motions. The cross-slide screw can be operated from the rear as well as the front

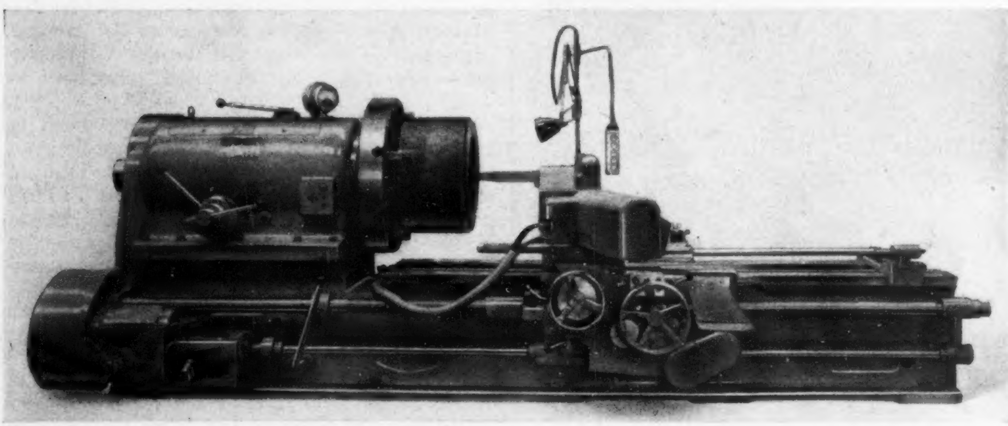


Fig. 1. Denham 20¾-in. centre heavy-duty profiling lathe for marine engine piston heads

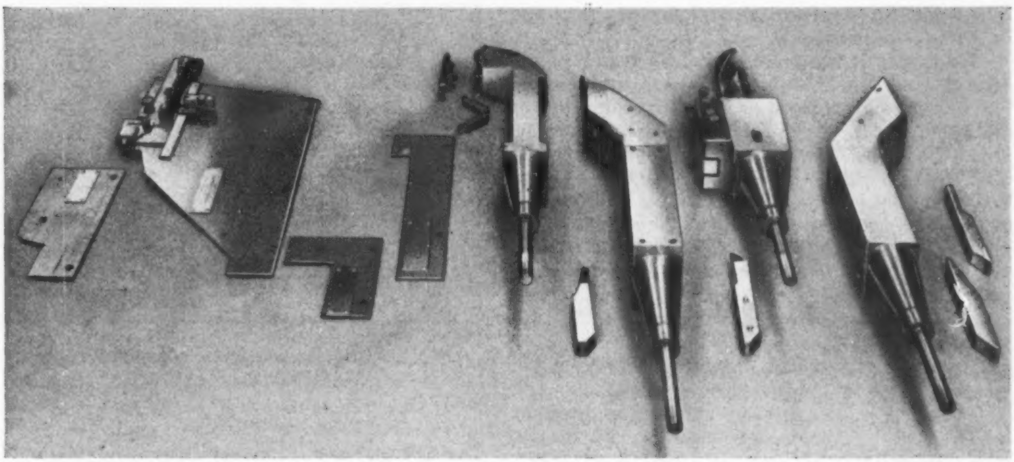


Fig. 3. Examples of the laminated plastics templates and the special boring bars employed on the lathe shown in Fig. 1

of the saddle, to facilitate setting. Since the lathe will not be employed entirely for operations on piston heads, a tailstock (not shown) was supplied, and a leadscrew fitted, to permit conventional turning and screwcutting to be undertaken on workpieces up to 84 in. long.

Operated by a 4½-in. diameter by 10 in. stroke hydraulic cylinder, the copying slide, shown in the close-up view Fig. 2, is set at an angle of 70 deg. to the work axis for machining the piston heads, but it can be swivelled through a full circle on the cross-slide. The tool slide has an adjustment of 4¼ in. on dovetail guideways and is mounted on a swivel base so that it can be set parallel with the work axis irrespective of the angular position of the copying slide. It has a B.S.S. No. 50 taper bore to take a range of special boring bars and a hardened steel holder for standard turning and facing tools. The template carrier is mounted in dovetail guideways at the front end of the cross slide and is prevented from moving with the saddle by a rod attached to a bracket at the right-hand end of the bed. This bracket is mounted on a casting secured to the main bedways, and can be adjusted with the cross-slide to maintain alignment with the template carrier.

Templates of laminated plastics material, and boring bars made from high-duty iron castings fitted with steel plates for vibration damping, have been developed by the company in collaboration with P.E.R.A. for profiling operations on piston heads. At the left in Fig. 3 may be seen examples of templates, and at the right, boring bars.

Piston heads are delivered to the lathe in the rough machined condition, and approximately $\frac{3}{16}$ in. of metal is removed from all diameters during the profiling operations. Fig. 4 is a sectional view of a piston head, showing the shape of the profiled surfaces. During the machining operations, the work is held in a 36-in. diameter independent 4-jaw chuck, and facing and turning at

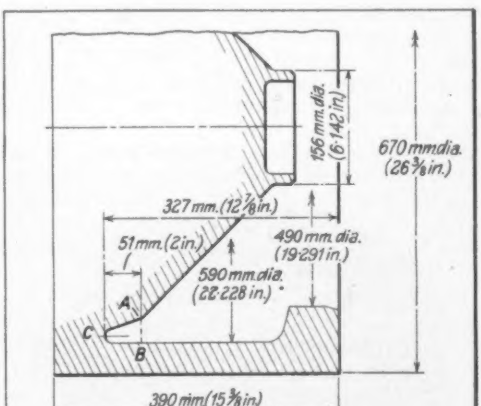


Fig. 4. Sectional view of part of a piston head for a Doxford marine diesel engine showing the profile shape produced on the Denham lathe. The work is held in a 36-in. 4-jaw chuck

the front end is carried out without the use of the copying equipment.

Next, the central recess is drilled and profile bored, and the 156-mm. diameter and conical portion are copy turned as far as indicated by the dotted line *AB*. At the following operation stage, the 490- and 590-mm. diameters and the angle and radius between them are profile bored, again as far as the line *AB*. Subsequently, the 51-mm. deep annular groove at the left-hand side of the line *AB* is turned from the solid, roughly to the required shape. Profile boring of the inner, conical, surface of this groove between the points *A* and *C*, and the outer surface between the points *B* and *C* are next completed at separate operations.

Except for the rough turning operation on the groove, separate roughing and finishing cuts are taken on the various surfaces with tungsten carbide tools. Cutting speeds and feeds of 200 ft. per min. and 0·01 in. per rev. for rough turning and boring, and 400 ft. per min. and 0·005 in. per rev. for finishing are employed. The entire profiling operations for a piston head are performed in a floor to floor time of 12 hours, whereas a period of 30 hours was previously required for producing the profile shape by conventional turning and boring, with the aid of sheet metal templates.

Brook C-type Drip-proof Motor

Brook Motors, Ltd., Empress Works, Huddersfield, have recently introduced the new British Standard ventilated motor, shown in Fig. 1, to draft specification CW (ELE) 6246 for dimensions, and to the amended B.S. specification 2613 for electrical performance with Class E insulation. It is available in a range of sizes from ½ to 50 h.p.

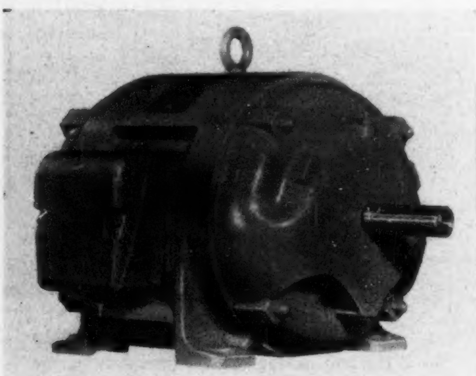


Fig. 1. Brook C-type Drip-proof Motor

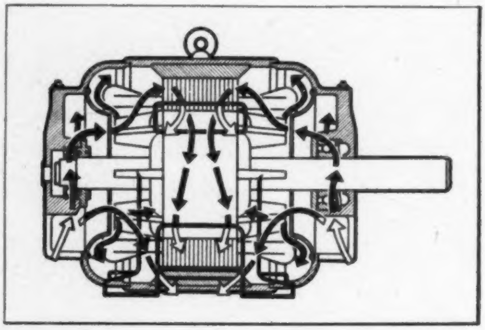


Fig. 2. Diagram Showing the Path of the Cooling Air Through the C-type Motor

The use of new insulation materials, improved ventilation, and compact design have enabled the size of a motor for a given output to be reduced substantially, with a corresponding saving in production costs.

Cooling air is drawn into the ends of the motor and guided by pressed steel deflectors, which also afford additional protection for the end windings, and after passing over the windings, is expelled through openings in the yoke castings, as shown diagrammatically in Fig. 2.

The former B.S. specification 168 allowed a maximum temperature rise of 40 deg. C., which allowed for sustained overloads. In the amended B.S.S. 2613, for electrical performance, a maximum temperature rise of 65 deg. C. is permitted under continuous maximum rating conditions, and extensive tests on the new motors have indicated good starting performance and exceptionally cool running, so that the temperature for full output is well below the limit imposed.

The cast iron terminal box can be turned to four positions, as can the end shields, so that drip-proof protection can be maintained whether a motor is mounted on the floor, wall, or ceiling. Shafts are of 40-ton tensile steel, the rotors have integrally-cast fans, and the shaft assemblies are dynamically-balanced to insure quiet running on the pre-loaded medium ball bearings.

A range of motors similar in appearance, except that the shaft extensions are of smaller diameter, is being produced to the NEMA (American) re-rate specification. These motors have class A insulation and are designed for operation on 60-cycle supply. They are marketed in the U.S.A. by the Brook Motors subsidiary company in Chicago, and by agents in Canada. It is stated that one-twelfth of Brook production was sold in the U.S.A. last year.

News of the Industry

Manchester and District

DEMAND FOR PIG-IRON UNCHANGED.—Conditions in the Lancashire foundry trade appear to be neither better nor worse than they have been of late, and the position continues to be reflected in the demand for pig-iron. All descriptions, including haematite, are readily obtainable and buying operations are largely confined to meeting current needs. An early expansion of demand is not anticipated, although there is a possibility of an increase in activity in some sections of the light castings industry as a result of the new credit facilities which are being provided. Derbyshire No. 3 iron is quoted at £21 1s. 3d. per ton for delivery in Lancashire, and Staffordshire low-phosphoric iron at £24 1s. 3d. and West Coast haematite iron at £25 5s. 0d., both delivered Manchester.

STEADY CALL FOR HEAVY STEEL PRODUCTS.—Business in heavy steel plates, large-diameter bars and certain other steel materials is maintained at a fairly steady level against old commitments. The bulk of fresh orders which are being placed for steel materials are on the basis of early rolling programmes, and there is evidence of keen competition among the mills for the tonnages available.

TWEEDALES & SMALLEY, LTD., Castleton, Rochdale, have received a substantial contract for textile machinery from Iran, which, it is expected, will enable all departments to return to full-time working in the near future.

LUKE & SPENCER, LTD., Broadheath, are experiencing a brisk demand for their full range of abrasive wheels and segments, including Lukspenite, Vitramic, and Borolite types, and ranging in sizes from ¼ to 48 in. diameter. On the grinding machine side, we may note that single- and duplex-wheel high-speed snagging grinders and single and double wet tool grinders of various sizes are in progress, also portable swing-frame machines equipped with abrasive wheels of 16 and 20 in. diameter.

CHARLES S. MADAN & CO., LTD., Broadheath, are busy with the production of Airhydropumps, of small, medium and large capacities, for the hydraulic testing of valves, castings, and pressure vessels, and some interesting development work is in hand. A steady demand is reported for Vortex revolving lathe centres of various sizes.

TAYLOR TOOLS & SUPPLIES, LTD., Broadheath, have orders for a variety of belt grinding and polishing machines, of both standard and special designs. These machines include 9-in. wet belt grinders, of both hand and automatic types, internal strapping and deburring machines, and a large vertical backstand machine.

P.I. CASTINGS (ALTRINCHAM), LTD., Atlantic Street, Altrincham, are well placed for orders, from the general engineering industry, for castings produced by the investment process. Some 750,000 investment castings, varying in weight from 0·75 to 1,600 gm., are being produced annually at these works for approximately 80 different branches or sections of the engineering industry. The Picast process, which is employed, differs from other investment techniques in certain essentials, but wax is used exclusively for the expendable patterns. Since our last visit another high-frequency induction melting furnace has been provided in the foundry and another milling machine in the tool room.

ESSEX TOOL & GAUGE CO., LTD., Navigation Road, Altrincham, have orders for a variety of milling, grinding, boring and inspection fixtures and drill jigs for the motor-car, aircraft, agricultural, and electrical engineering industries. Other products include single- and double-ended plug gauges; plate gauges; alignment bars; ball-end test bars; adjustable bench centres; square testing fixtures; and sine bars, sine plates and sine bar centres of 15-, 20- and 25-in. capacities.

EDIBRAC, LTD., Hartington Road, Broadheath, are busy with the production of both standard and special tungsten-carbide tips. In addition, a wide variety of Centurion tipped tools is in progress for turning, planing, boring, drilling, reaming, milling, sawing, and copy profile turning, also wear resisting components, gauges, lathe centres, and rock and coal drill bits.

RENOLD CHAINS, LTD., Wythenshawe, Manchester, have issued an illustrated brochure which deals with the range of Renold products for industry. Attention is drawn to the standard stock series chain drives up to 140 h.p., and the standard design series up to 4,000 h.p., also to special purpose chains, such as the corrosion resistant Mark 5 series, and the cranked link type Mark 3 series. For mechanical handling, chains are available with breaking loads from 3,000 to 85,000 lb. (up to

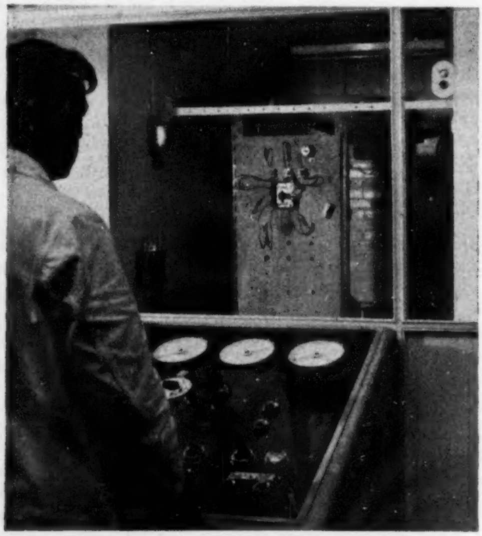
300,000 lb. for special requirements) together with attachments and wheels. Other items include chain drive accessories such as chain-cases and lubricators, a range of shaft couplings, and clutches.

CRAVEN BROTHERS (MANCHESTER), LTD., Reddish, Stockport, have recently supplied a 30-ft. vertical boring and turning mill to the Australian State Dockyard, at Newcastle, New South Wales. To cater for a general run of work up to 15 ft. diameter, also for occasional workpieces up to 30 ft. diameter, the design is based on a 25-ft. fixed-column mill, with a 22-ft. diameter table, but with the two columns spaced out on bed wings and the cross-slide and top beam extended to accommodate a swing of 30 ft. 3 in. diameter. Drive is taken from an 80-h.p. variable-speed reversing motor, through V-belts and a 3-speed gearbox, and the table speeds range from 0·25 to 7·5 r.p.m. A constant feed per rev. is maintained regardless of any change in the speed of the table. We hope to describe this machine more fully at a later date.

H. B.

Short-circuit Testing Installation

J. A. Crabtree & Co., Ltd., Lincoln Works, Walsall, Staffs., have recently installed equipment for the short-circuit testing of their range of circuit breakers and contactors, at currents up to 10,000 amp.



A view showing part of the control desk for the Crabtree short circuit testing equipment. The product to be tested is mounted on the panel seen in the background

Current is supplied by an 800-kVA alternator which gives a 400-volt 3-phase supply, and has a rotating salient pole field. A direct drive to the alternator is provided by a 100-h.p. squirrel cage motor which has a synchronous operating speed of 1,500 r.p.m., and is controlled by an automatic transformer starter, incorporating a Korndorffer circuit. From the alternator, the current is fed direct to a main circuit breaker of 1,000 amp. nominal rating, the breaking capacity of which considerably exceeds the maximum short circuit current supplied by the alternator. Reactors and resistors are connected into each phase of the supply, which enables the current and power factor to be controlled down to 100 amp. The building in which the alternator and associated equipment is installed, has forced air ventilation.

Housed in a separate room is a desk from which the entire installation is controlled by push buttons and switches, also a vertical panel for mounting the item to be tested. Part of the control desk, and the panel are shown in the accompanying illustration. The actual test is carried out by closing a "make" switch by pressing a push button. Equipment is provided for the preparation of oscillograms while tests are being carried out, and an adjacent photographic dark room affords facilities for processing.

Provision is made in the busbar system, between the alternator and the "make" switch, for the connection of transformers to give higher currents for testing purposes if required. Alternatively, D.C. current up to 1,500 amp. at 250 volts, or more than 2,000 amp. at 500 volts, can be applied to the product to be tested, by storage batteries.

Inspector of Factories Report for 1957

The Annual Report of the Chief Inspector of Factories for the year 1957 shows that a total of 174,062 accidents of all kinds, involving injury, was notified, also 651 more which were fatal. For the year 1956, the corresponding numbers were 184,098 and 687, so that the 1957 figures showed a reduction of more than 5 per cent in both fatal and non-fatal accidents. Despite the specific prohibition, in the Factories Acts, of the cleaning of machinery in motion, 428 women and young persons are reported as having been injured in this manner during the year. Although the total number of accidents caused by power-driven machinery in factories has again fallen, there were 30 more power press accidents, and 14 more accidents involving planing machines, than in

1956. It may be noted that copies of a preliminary draft of regulations governing the use of power presses in factories have now been sent to interested organizations for their comments.

Attention is drawn to the problems involved in ensuring safe working conditions on pressure die casting machines, and reference is made to a report issued by a Safety Committee of the Zinc Alloy Diecasters' Association, which recommends that the principle of mechanical restraint should be incorporated to prevent the dies of such machines from closing when the danger area is exposed. It is pointed out that there is a number of simple guards which go a considerable way towards providing safe conditions, and the adoption of such guards is advised as an interim measure. Recommendations have also been made for safe procedures in tool setting on die casting machines.

Reference is made to dust control in foundries, and it is stated that scientific research has been proceeding on the chemical and physical reactions which occur at the sand-to-metal surface when molten metals are poured into moulds and on the complicated organic reactions which result from the use of fluxes on molten metals. In addition, work is in progress on the collection and assessment of dust samples, and an extensive survey of aerodynamic conditions at mechanized knock-outs has been carried out. As a result of intensive development work, dust from pedestal and swing-frame grinders has been satisfactorily controlled, and a low-volume high-velocity system of local exhaust ventilation has been applied to a wide range of portable tools.

The replacement of lifting appliances of wrought iron by those made from steel is reported to be making rapid progress, and the change has been accelerated by the issue of a series of British Standards relating to such gear. With the increasing use of braided slings incorporating triangular terminal links, the M.E.R.L., East Kilbride, has evolved a formula of design and safe-load determination for such units.

Statistics quoted in the section of the report concerning the use of ionizing radiations show that at the end of 1957 approximately 400 factories were using radio-active isotopes and over 100 were known to be operating X-ray apparatus. It is believed that the hazard to health is greatest where sealed sources are being used for radiography and fluoroscopy. Where these sources are applied as thickness gauges, the risks occur mainly in handling them when a machine is being dismantled either for maintenance or for removal of the source.

The report includes a whole chapter devoted to research, and another on safety training. It is published by H.M. Stationery Office (price 5s. net).

Personal

Mr. K. Arkless, A.M.I.Mech.E., formerly chief technical consultant to the company, has been appointed a director of Monks & Crane, Ltd., Garretts Green Lane, Birmingham, 33. Mr. Arkless, who had previously been with the Nuffield Group of Companies, joined the organization in 1949, and later became responsible for technical service. He has a wide knowledge of cutting tools and application techniques.

Mr. J. Parsons

Mr. John Parsons, B.Com. (London), M.B.A. (Harvard), has been appointed to the board of directors of Richard Lloyd, Ltd., Birmingham and Tenbury Wells. He was formerly assistant general works manager of Rolls-Royce Ltd., Derby.

Mr. D. Nicholson and Mr. Daniel Cameron have retired from Charles Churchill & Co., Ltd., Coventry Road, South Yardley, Birmingham. For the last twelve years, Mr. Nicholson held the position of sales manager for that company, prior to which he was successively manager for Scotland and the North Eastern areas and London manager of the company's small tools division. He first joined the company in 1929. Mr. Cameron was first appointed representative for Scotland in 1928, and some ten years later became manager of the Scottish branch. He had had wide experience in industry before joining the company, and during the last war served as a member of the Area Committee for Scotland for machine tool control.

Industrial Design Conference

A one-day conference on "Industrial Design and the Engineering Industries" is being organized by the Council of Industrial Design, 28 Haymarket, London, S.W.1, in collaboration with the Birmingham Exchange and Engineering Centre, and will be held at the premises of the latter organization on November 12. This conference, which will be the first of its kind to be held in this country, will be concerned with the relationship of industrial design to the engineering industries, and with steps that may be taken to improve the form and function of engineering products. The methods whereby the best use can be made of the services of industrial designers will also be considered.

The conference will be opened by the Rt. Hon. Lord Mills, K.B.E., Minister of Power, and the speakers will include Mr. G. S. C. Lucas, O.B.E., M.I.E.E., director and chief electrical engineer of British Thomson-Houston Co., Ltd., and Mr. Louis Schuler, managing director of L. Schuler, A.G., Goeppingen, Germany.

Industrial Notes

ENGLISH ELECTRIC CO., LTD., Stafford, have received an order for a 33,000-kW. steam turbo-alternator set, condensing and feed heating plants, and auxiliary apparatus for the United Kingdom Atomic Energy Authority's new advanced gas-cooled reactor.

BRITISH INSULATED CALLENDER'S CABLES, LTD., 21 Bloomsbury Street, London, W.C.1, have opened a new stock depot for a comprehensive range of rubber, thermoplastic, and mineral insulated cables, and accessories, at Oakcroft Road, Chessington, Surrey (telephone No. Lower Hook 2323). The new depot will be managed by Mr. H. M. Hudson.

PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2. The South-Western Region headquarters of this company will be accommodated in a new building shortly to be erected in the business centre of Bristol. Of 4-storey construction, the building will provide a total floor space of 16,000 sq. ft., and will incorporate offices, a showroom, a store, and demonstration rooms.

AUSTRALIAN POWER STATION CONTRACT.—The State Electricity Commission of Victoria, Australia, has placed a contract for more than £5,000,000 with Babcock & Wilcox, Ltd., Australia, a subsidiary of the British firm. More than one-fifth of the work will be executed in the United Kingdom at the Renfrew works. The contract is for boiler plant for the Yallourn power station extensions in Victoria.

PLASTICS VERSUS STEEL BIBLIOGRAPHY.—The Science and Commerce Department of the Sheffield City Libraries has recently issued Research Bibliography No. 65, which contains nine references to discussions, published since 1953, on the use of plastics in place of steel. Copies of this bibliography are available, free of charge, from the City Librarian and Information Officer, Central Library, Surrey Street, Sheffield, 1.

THE NORTH LONDON PRODUCTIVITY COMMITTEE, in association with the British Productivity Council, will hold a conference on "Incentives and Productivity" on October 2, at 10 a.m., in the Council Chamber, Federation of British Industries, 21 Tothill Street, London, S.W.1. On November 20, there will be a conference on "Cost Reduction Programmes," and on January 22, 1959, a conference on "Variety Reduction," both at the same address.

B. & K. LABORATORIES, LTD., 57 Union Street, London, S.E.1, have recently opened an "instrumentation centre" at 4 Tilney Street, Park Lane, London, W.1, to provide improved sales facilities in connection with the wide range of electronic instruments and equipment for which they are the distributors. Examples from the range will be displayed at the centre, and a comprehensive library of technical literature will be maintained.

TILGHMAN'S, LTD., Broadheath, Altrincham, Cheshire, have recently acquired the sole selling rights in the British Isles for the range of pneumatic tools manufactured by Gebr. Bohler & Co., Vienna, Austria. This range includes tools for the metal-working industries, also mines and quarries, and to handle this agency, Tilghman's, Ltd., have formed a pneumatic tools division at 1 Chester Street, London, S.W.1, which will be under the control of Mr. F. Marsh.

EDGAR ALLEN & CO., LTD., Imperial Steel Works, Sheffield, 9, inform us that their Powder Metals Division, for the manufacture of hard metals used in the production of the Allenite range of cutting tools and tips, can now offer nine different grades, to provide for the machining of all types of ferrous and non-ferrous materials. Research and development are also being carried out to extend the range of items made by the powder metallurgy process, such as magnets.

STEEL PRODUCTION IN AUGUST.—The Iron and Steel Board reports that British steel production in August averaged 299,200 tons a week, compared with 373,400 tons in August last year. Production was especially low in Scotland and the North-East Coast areas, where holidays were extended because of the fall in demand for plate and other heavy rolled products. It is estimated that current steel consumption is about 5 per cent below last year's level and that the much greater fall in production is due to the reduction in stocks and in exports.

SIR JOHN CASS COLLEGE, Jewry Street, Aldgate, London, E.C.3.—Among the courses arranged for the 1958–59 session may be noted those on the following subjects: mathematics for B.Sc., M.Sc., and Ph.D.; relaxation methods for the solution of ordinary and partial differential equations; statistical mechanics; absorption spectroscopy; and, statistical methods in scientific and industrial reseach. Full details of these, and other day and evening courses, can be obtained by application to the secretary at the above address.

DIAGRIT DIAMOND TOOLS, LTD., inform us that they have taken possession of new factory premises at Station Road, Staplehurst, Tonbridge, Kent (telephone No. Staplehurst 479). Among the new equipment installed may be noted a 45-kW atmosphere-controlled furnace, a 500-ton hydraulic press, and two powder-cleaning transfer furnaces. The firm's existing premises in Pattenden Lane will be retained, as a heavy machine shop for the manufacture of moulds, and for maintenance purposes, but the manufacture of diamond wheels will be concentrated at the new premises.

DESIGN COURSE ON WELDED STRUCTURAL STEELWORK.—A course of lectures on the detail design of welded structural steelwork has been organized by The Institute of Welding, 54 Princes Gate, London, S.W.7, and will be held at the Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, on nine

successive Monday evenings starting on October 13. Enrolment forms for this course, which is similar to those held previously in London, Birmingham, and Manchester, can be obtained on application to the Secretary of the Institute of Welding at the above address.

BROOK MOTORS, LTD., Empress works, Huddersfield, announce the formation of a Canadian subsidiary company, entitled Brook Electric Motors of Canada, Ltd., with offices at 250 University Avenue, Toronto, which will commence business on October 1. Brook Motors, Ltd., have had agency representation in Canada since 1914.

IMPROVED SCHAUBLIN COLLET PRODUCTION FACILITIES.—Moser Cams & Tools, Ltd., 465 Hornsey Road, London, N.19, who are agents for Schaublin S-A, the Swiss collet manufacturers, inform us that their principals have extended their new factory at Delémont. Here, the production of collets, feed fingers, carbide bushes, etc., principally for Swiss and other Continental makes of machine tools, has been increased and earlier deliveries can now be made.

FINNISH POWER PLANT CONTRACT.—Three British firms—all members of the Hawker-Siddeley group—have been awarded a £500,000 contract for free piston and gas turbine power station equipment for Finland. Secured in the face of keen Continental competition, the order is stated to be the first for this type of plant for Northern Europe. The order has been placed with National Free Piston Power, Ltd., London, and the equipment will be manufactured by the National Gas & Oil Engine Co., Ltd., Ashton-under-Lyne, Lancs., and the Brush Electrical Engineering Co., Ltd., Loughborough.

A PUNCHED-CARD OPERATED TYPEWRITER has been developed by Remington Rand, Ltd., Dinneford House, 12–14 Clipstone Street, London, W.1, and is on show at the Business Efficiency Exhibition at City Hall, Manchester. With this machine, invoices and schedules can be produced automatically from punched-cards, also large quantities of letters, such as those required for a mail campaign. The machine is also suitable for use as an output device in an electronic data processing system and is to be developed further, so that it may be employed as a complete input/output typewriter in conjunction with such systems.

HOLT & MOSEDALE, LTD., have moved to a new factory and their address is now Holdale Works, Doulton Road, Old Hill, Staffs. (telephone number, Cradley Heath 66421). Among the products of the company may be mentioned jigs, tools, fixtures, gauges, moulds and dies, and the plant includes Newall jig borers, Jones-Shipman grinding machines, and Kearney & Trecker milling machines. A separate department is concerned with the design and production of special purpose and prototype machines, and is at present occupied with work for the electrical and aircraft industries. In addition the company makes spray lubrication equipment for drawing and forging dies, which is used, for example, to facilitate the forging of blades for aircraft gas turbines.

INCORPORATED PLANT ENGINEERS.—During a meeting to mark the transfer of the headquarters of this Institution from the Midlands to 2 Grosvenor Gardens, London, S.W.1, it was stated that membership, which at the time of its inception in 1946 numbered only 120, is now in the region of 4,000. In this connection, it may be noted that requirements for membership have been so framed that applicants with modest academic qualifications are not necessarily excluded, since it is believed by the Council that there are many such men who, over a period of years, have amassed a considerable store of experience, and are thus able to make an invaluable contribution to industrial efficiency. Students who hold an Ordinary National Certificate in either mechanical or electrical engineering can obtain certificates in plant engineering after the satisfactory completion of I.P.E.-approved courses at the City and Guilds of London Institute, Gresham College, Basinghall Street, London, E.C.2.

Coming Events

THE PLASTICS INSTITUTE.—*North Western Section.* October 3, at 6.45 p.m., at the Textile Institute, Blackfriars Street, Manchester; lecture on "Polyester Resin Glass Fibre Moulding by the Matched Metal Moulding Method," by H. R. Everard.

INSTITUTION OF PRODUCTION ENGINEERS.—*Nottingham Section.* October 1, at 7 p.m., at the Reform Club, Victoria Street, Nottingham; lecture on "Thermal Insulation of Factories," by the Gypsum Plasterboard Development Association. *Dundee Section.* October 1, at 7.30 p.m., at the Windmill Hotel, Arbroath; lecture on "Copy Turning —Its Developments and Techniques," by a representative of Vaughan Associates, Ltd. Colour sound films will be shown. *Reading Section.* October 2, at 7 p.m., at the Great Western Hotel, Reading; paper on "Some Thoughts on the Scientific Method," by F. V. Barker.

Churchill Grinding Demonstration

Six grinding machines from the range made by The Churchill Machine Tool Co., Ltd., will be demonstrated in the showrooms of Charles Churchill & Co., Ltd., Coventry Road, South Yardley, Birmingham, from September 29 to October 3 (9 a.m. to 5 p.m. daily). The machines on view will include a BW plain grinder fitted with a power-operated, wheel-head mounted, wheel forming device, and arranged for automatic sizing with hydraulic diminishing feed controlled by the M.P.J. electro-sizing gauge; an AW Fulcro-sizer fully automatic plain grinder, on which the feed is applied by tilting the table carrying the workpiece towards the grinding wheel; an HBM automatic sizing internal grinder on which both plunge and traverse grinding can be carried out; and an NB surface grinder equipped with the Diaform wheel truing device.

Machinery from Dollar Area

A relaxation of restrictions on the import of goods from the dollar area was recently announced by Sir David Eccles, the President of the Board of Trade, at the Commonwealth Economic Conference. Most of the controls on the import of machinery from this source have been removed, the only exception being a limited range of specialized machinery which will remain under restriction. The relaxations were effective immediately after the announcement, and apply to such equipment as machine tools, electric motors, switchgear, typewriters and office machinery, from both Canada and the U.S.A.

U.S. Machine Tool Exports

The following table gives the quantities and value of exports of various classes of machine tools from U.S.A. during 1957:—

	Number	Value $
Engine and tool-room lathes ..	1,187	3,598,042
Light duty and bench lathes ..	1,866	640,874
Turret lathes	453	3,096,995
Other lathes	835	16,822,862
Vertical boring and turning mills ..	68	1,667,488
Boring machines	288	8,672,590
Tapping and threading machines ..	1,497	2,949,187
Milling machines	1,191	11,122,810
Gear-cutting machines	502	11,131,468
Gear grinding and finishing machines	199	3,547,356
Drilling machines	2,293	5,674,004
Planing, shaping and slotting machines	314	2,262,720
Surface grinding machines	537	3,470,792
Tool and cutter grinding machines..	1,273	2,439,628
Other grinding machines	584	13,146,121
Honing and lapping machines ..	350	1,909,342
Broaching machines	84	1,731,530
Sheet and plate metal-working machines	4,965	31,650,055
Forging machines and hammers ..	456	8,438,169
Metal-forming machines	—	8,797,585
Other machines	11,024	13,052,058

Gauge and Tool Makers' Luncheon

The next trade luncheon of The Gauge and Tool Makers' Association, Standbrook House, Old Bond Street, London, W.1, will be held at the Savoy Hotel, London, on October 22. The Guest of Honour and principal speaker will be Mr. Ross Roy, president of Ross Roy Inc., Detroit, Michigan, U.S.A.

Books Received

CAREERS IN PLASTICS. Third Edition, August, 1958. The Plastics Institute, 6 Mandeville Place, London, W.1, 20 pp.

Intended for senior scholars, and for those who are responsible for guiding them in the choice of a career, this book gives an outline of the scope and variety of careers which can be found in the plastics industry. After describing the main sections into which the industry is divided, the book discusses the possible routes by which the entry can be made and the technological, professional, and academic qualifications which can be obtained. There is also a list of teaching centres approved by the Plastics Institute.

Obituary

MR. HARRY S. BROOM.—We regret to report the death, on September 12, of Mr. Harry S. Broom, M.I.Mech.E., founder, chairman and joint managing director of Broom & Wade, Ltd., High Wycombe, Bucks. He was in his 84th year.

The very successful business with which he was associated was established in 1898, and the early activities included the production of wood-working machinery for the furniture industry. Subsequently the emphasis was shifted to air compressors and pneumatic equipment, and for many years the company has specialized in this field. In addition, during the 1914-1918 war 4·5-in. howitzer shells were produced, and in the second world war considerable work was undertaken in connection with Churchill tanks.

Mr. Broom lived to see the organization grow from small beginnings to a world-wide business with subsidiary companies in South Africa, Australia, and Canada, and nearly 70 overseas agents. To-day some 1,400 people are employed at the High Wycombe headquarters alone. He was keenly concerned with the welfare of his employees, and introduced a profit sharing scheme more than 30 years ago.

Mr. H. S. Broom

On the occasion of his 80th birthday, his "friends and competitors" in the compressed air industry arranged a luncheon and presentation.

Mr. Broom was in his office less than 24 hours before the beginning of a short illness from which, unfortunately, he did not recover.

Engineering Drawing Practice

B.S. 308A (Engineering Drawing Practice), which has recently been issued, is an abridged edition of B.S. 308, and is intended for the use of students who are in the early stages of their technical education. Most of the important information contained in the parent edition is included in the new standard, and each page of the latter bears a cross-reference to the relevant page of the original standard. Extending to 40 pages, the new standard is divided into two sections. Section 1 is concerned with general practice and section 2 with dimensioning and tolerancing. The clauses of the original standard that have been abridged or omitted are: (1) Sizes of Drawings and Tracings; (2) Layout of Drawings; and (3) Numbering and Referencing from section (1); and (14) Toleranced Dimensions; (18) Tapered Features; (19) Geometrical Tolerances; (20) Tolerance Notes for Roundness; (21) Profiles and Curved Surfaces; (22) Machining and Roughness Symbols; and (23) Typical Examples of Engineering Drawings, from section 2.

Copies of the new standard can be obtained from the British Standards Institution, 2 Park Street, London, W.1. Price 4s. 6d. (less one-third discount for students.)

Machine Tool Share Market

A steady to firm tone was maintained in most sections of the stock markets during the period under review, and turnover was on a satisfactory scale and showed a tendency to expand gradually.

British funds and similar high grade investment stocks were seen to advantage and finished higher and on a good note.

Commercial and industrial markets, after remaining quietly steady for the most part, became very active and cheerful.

Share prices advance on selective demand, and by the close, numerous substantial gains had been recorded.

Among machine tool issues, Clarkson Engineers rose 1s. 3d. to 15s.; Ambrose Shardlow, 2s. 6d. to 40s. 6d.; and Thos. W. Ward, 1s. to 81s. On the other hand, Edgar Allen lost 6d. at 32s. 9d.; Asquith Machine Tool, 6d. at 19s. 6d.; British Oxygen, 6d. at 39s. 6d.; Chas. Churchill, 1½d. at 5s. 1½d.; Coventry Gauge & Tool, 1½d. at 15s. 10½d.; Churchill Machine Tool, 2s. 6d. at 16s. 9d. x.d.; and Alfred Herbert, 7½d. at 35s. 7½d.

CHURCHILL MACHINE TOOL CO., LTD.—Interim dividend 7½ per cent.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrongs, Stevens & Son, Ltd.	Ord.	5/-	8/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	32/9
" "	5% Prf.	£1	14/9*xd
Arnott & Harrison, Ltd.	Ord.	4/-	14/6
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	19/6
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	31/9
" " "	5% Cum. "A" Prf.	£1	15/6
" " "	6% Cum. "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	88½
British Oxygen Co., Ltd.	Ord.	£1	39/6
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	3/10½
Broom & Wade, Ltd.	Ord.	5/-	12/1½
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/9
Butler Machine Tools Co., Ltd.	Ord.	5/-	7/-
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	11/3
Churchill (Charles) & Co., Ltd.	Ord.	2/-	5/1½
" " "	6% Cum. Prf.	£1	26/3
Churchill Machine Tool Co., Ltd.	Ord.	5/-	16/9xd
" " "	6% Cum. Prf.	£1	18/6
Clarkson (Engrs.), Ltd.	Ord.	5/-	15/-
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/6xd
" " "	4½% Cum. Prf.	£1	14/6xd
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	15/10½
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	7/4½xd
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/3
" "	4½% Red. Cum. Prf.	£1	13/9
Expert Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/6xd
Greenwood & Batley, Ltd.	Ord.	£1	50/7½
Harper (John) & Co., Ltd.	Ord.	5/-	15/6
" "	4½% Red. Cum. Prf.	£1	13/1½xd
Herbert (Alfred), Ltd.	Ord.	£1	35/7½
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	12/-
" "	"B" Ord.	5/-	11/6
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	23/-xd
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	45/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/7½
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/3
Kitchen & Wade, Ltd.	Ord.	4/-	8/3
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	8/3
Modern Engineering Machine Tools Ltd.	Ord.	5/-	10/7½
Newall Engineering Co., Ltd.	Ord.	2/-	4/9
Newman Industries, Ltd.	Ord.	2/-	2/3
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	3/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	20/-
" " "	5½% Cum. Prf.	£1	25/3xd
Pratt (F.) & Co., Ltd.	Ord.	5/-	21/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/-
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	40/6
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/9
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	11/9
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	6/9
Tap & Die Corporation, Ltd.	Ord.	5/-	7/6xd
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	17/6
Ward (Thos.) W.), Ltd.	Ord.	£1	81/-
" "	5% Cum. 1st Prf.	£1	15/6
" "	5% Cum. 2nd Prf.	£1	24/-
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite

English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0
Welsh	£25 6 6

Steel Products

Medium plates	£45 11 6
Mild steel plates, ordinary*	£42 2 0
Boiler plates*	£44 12 0
†Flat bars 5 in. wide and under; †Round bars under 3 in.	£40 0 6
Billets, rolling quality, soft U.T.	£32 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£258 0 0

Copper

Cash (mean)	£211 12 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£276 15s. 0—£277 0 0
Rods 3/16 in. to ½ in. diam.	£299 5 0
Tubes, 1¼ in. bore by 10 SWG, ton lots, per lb.	2s. 10d.
Wire rod, black, hot-rolled (¼-3/16 in.) English	£228 17 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean)	£65 7 6

Brass

Tubes, solid drawn, per lb.	1s. 7⅞d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£231 5 0—£233 15 0
Rods, ¼-3in. diam. (59 per cent copper)	1s. 10⅛d.

Yellow Metal

Condenser plates, per ton	£168 0 0
Rods, per lb.	1s. 11⅛d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d	£180 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean)	£70 17 6

Tinplates

‡U.K. Home trade:	
Handmill f.o.t. makers' works	£3 11 8¼
Cold reduced, f.o.t. makers' works	£3 7 4½
U.K. Export:	
Hot rolled basis, f.o.t. works' port	72s. 6d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	75s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works	£171 0 0

* N.E. Coast, N. Joint Area, Central Scottish Zone.

† U.T. soft basic.

‡ Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f, ex works 2 ton basis	£42 17 0
Free cutting black	£47 6 6

Reeled Steel Bars[1]

Single-reeled 1¼ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 6
Free cutting	£47 19 0

Precision-ground Mild Steel[2]

1-in. dia. + 0·00025-in. 4-ton lots, per cwt.	121s. 6d.

Bright Ground Stainless Steel Bars[3]

EN56AM (martensitic, free cutting)	£285
EN58AM (austenitic, free cutting)	£353

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.

Molybdenum "66"	5s. 10½d.
Molybdenum "46"	5s. 8½d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1½d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4·75/5·25 molybdenum + 6·0/6·75 tungsten + 1·75/2·05 vanadium per cent (5-6-2)	6s. 0½d.

Precision-ground, High-speed Free-turning Brass Rod[2]

⅜-in. dia. ± 0·00025-in. 2-ton lots, per lb.	2s. 5½d.

Grey Iron Rod

Die Cast[4] in random lengths 18 in. to 26 in. rough machined 1/16-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
⅝ or ⅞ in.	245s. 4d.	318s. 10d.
1 or 1⅛ in.	196s. 4d.	251s. 10d.
1¼ to 1⅝ in.	137s. 10d.	171s. 2d.
1¾ to 2 in.	106s. 2d.	125s. 11d.
2⅛ to 3½ in.	91s. 6d.	106s. 4d.
3⅝ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[4]

6-ft. lengths centreless ground + 0·010 in. Extra for hardenable alloy iron[5] Per cwt. net	⅝ or ⅞ in.	245s. 4d.
	1 or 1⅛ in.	196s. 4d.
	1¼ to 1⅝ in.	137s. 10d.
	1¾ to 2 in.	106s. 2d.
	2⅛ to 3½ in.	91s. 6d.

Stellite[6]

Welding Rods plain

¼ in. dia. per lb.	30s. 0d.

Toolbits

¼ in. sq. × 4 in., each	22s. 3d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester. 3 Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. 4 Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 5 "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. 6 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn: (Usaspead) over 1¼ to 2 in.	£59 17 6
Lead bearing (Usaled)	£64 4 0
Precision ground, 1¼ in.	£81 13 6

Bright Drawn

M.S. bars (M.M.C.) over 1¼ in. to 2 in.	£55 3 6
Square edge flats (Usaflat)	£72 0 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1¼ in. to 2 in.	£63 9 6
M.S. bars (EN3B) (Usamild) over 1¼ to 2 in.	£57 3 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1¼ to 2 in.	£72 19 0
35/45 ton tensile (EN6) (Usen) over 1 to 1¼ in.	£64 17 6
0·4 Carbon Normalised (Usaspead "40") over 1¼ in. to 2 in.	£66 19 6
Carbon manganese steel to Specification EN.16.T (Usaspead 5565), per ton	£127 11 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) ⅛ in. to 2½ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.) ⅛-in. to 2½-in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.) Genuine Stubs quality, per lb.	4s. 6d. less 27½%
M.M.C. quality, per lb.	2s. 5d. + 6½%
Boxes of 16 assorted sizes 1/16-in. to ⅛-in. dia.	7s. 6d.

Stainless Steel

K.E. 40.AM (Freecutting), per lb.	3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (2B8); Lead bronze	Prices on application

High-speed Steel

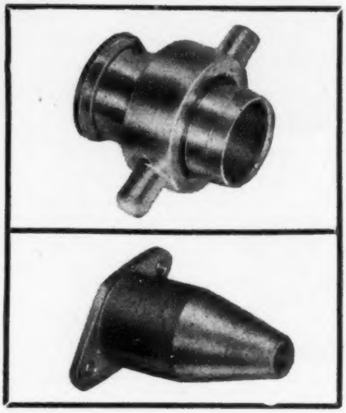
18 per cent tungsten. Prices on application.

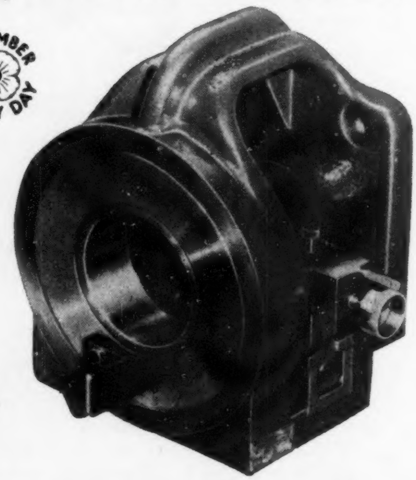
Toolholder bits: Usaspead "Super"; " "Supreme"; " Cobalt 10	List price

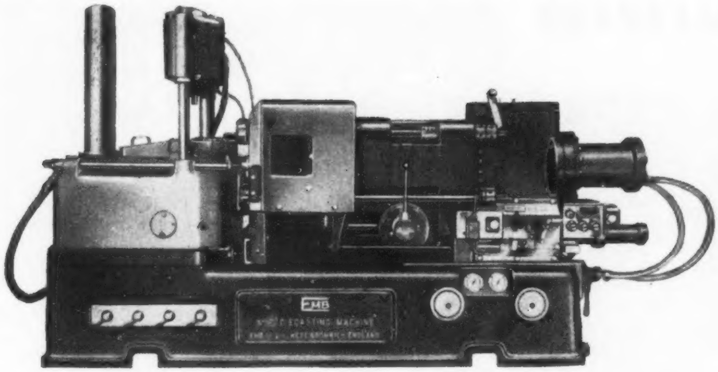
Shimstock

Steel assorted, per tin	3s. 6d.
Brass " "	7s. 3d.

6 Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.







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Size of Machine	No. 6	No. 10	No. 14	No. 20
Capacity in zinc base (lbs.)	¾	2¾	7	12
Capacity in Aluminium (lbs.)	—	1¼	4½	8
Max. die size (ins.)	8½×9½	16×10	24×14	30×20
Stroke of Platen ...	4½	6	9	12

On all but the No. 6 machine, transposing heads will cater for zinc base and aluminium alloys on the same machine.

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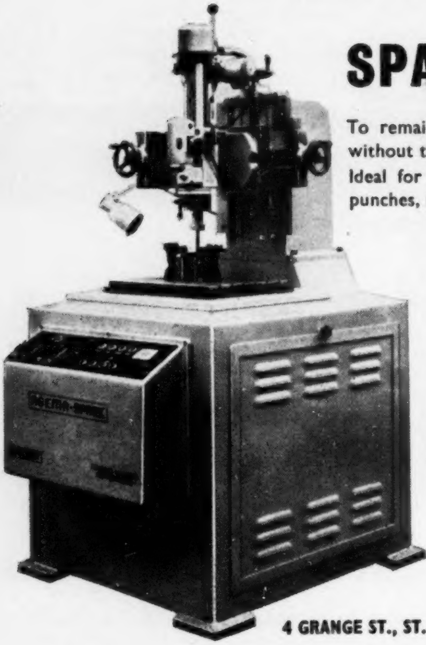

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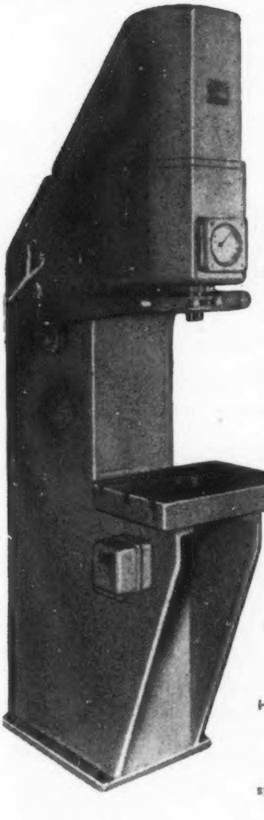
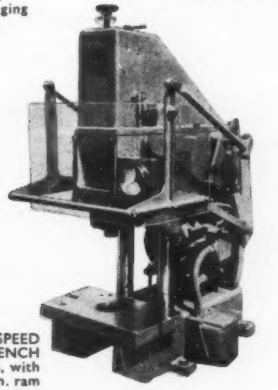


HIGH SPEED HYDRAULIC PEDESTAL PRESSES: 7½ and 15 tons, with high ram speed; open type welded frame; patented swinging arm precision ram guide system.



HIGH SPEED HYDRAULIC BENCH PRESS: 5 tons, with 1,000 in./min. ram speed; pre-set ram load control; fool-proof guarding system; power return for stripping.

D.Y.S. GENERAL PURPOSE UNIT: a self-contained unit comprising 2 h.p. motor; high pressure multi-plunger pump; reservoir, and control safety valves; oil filter and pressure gauge; push-button controls; to supply power to small presses, jacks, riveters, etc.

HYDRAULIC INDEXING TABLE: interlocked with press hydraulic circuit for automatic cycle; 4 or 8 stations; smooth shock-less movement and indexing to close limits; loading time adjustable between 1 and 10 seconds, or faster when provision is made for automatic feed.

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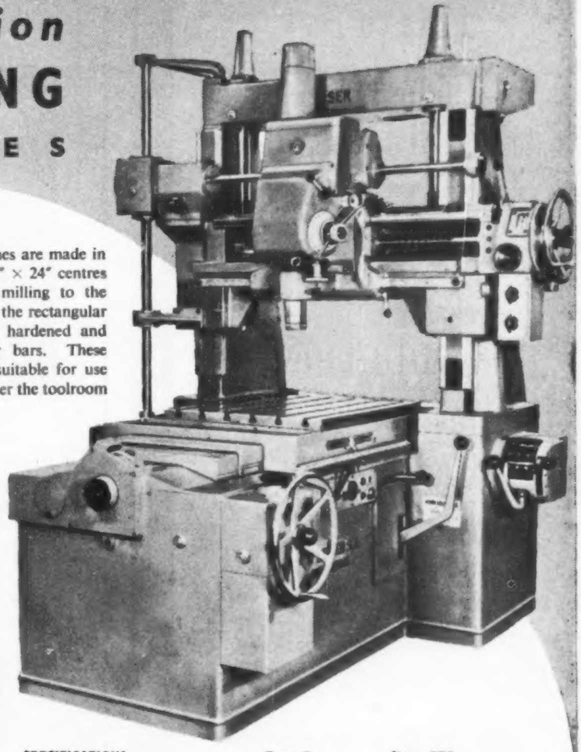
high precision JIG BORING MACHINES

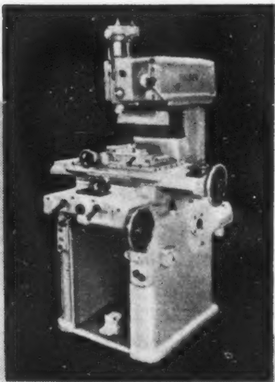


These high precision Jig Boring Machines are made in a range of sizes from 4" × 4" centres to 28" × 24" centres and are capable of boring, drilling and milling to the closest limits. All movements are based on the rectangular co-ordinate system and are controlled by hardened and lapped micrometer screws with corrector bars. These machines are quick in operation and are suitable for use with the latest types of carbide tooling in either the toolroom or the production shop.

Type 5 High Precision Jig Boring Machine.

This machine has a direct reading accuracy of 0·0001" and slide location accuracy of 0·0002" over its whole working range. The spindle is provided with 18 speeds from 45—2,000 r.p.m. and 6 automatic feeds in each direction from 0·0008"—0·008" per rev.

Power operation is fitted to the table, the boring head and the vertical movement of the cross beam. The precision of these machines is maintained over many years of service.



Type 3BA Jig Boring Machine.

SPECIFICATIONS	Type 5.	Type 3BA.
Working surface of table	29½" × 24½"	22" × 12¾"
Traverse of table slide	28"	16"
Traverse of transverse slide ..	20"	10"
Vertical travel of boring spindle ..	7"	5¼"
Maximum boring capacity	9"	2 5/16"
Maximum drilling capacity ..	1¼"	15/32"
Maximum clearance, spindle to table	28½"	23½"
Boring spindle speeds .. (18)	45 — 2,000 r.p.m.	120 — 3,000 r.p.m. (infinitely variable)
Automatic feeds of quill per rev. ..	0.0008" — 0.008" (6)	0.0012" — 0.0024" (2)

Type OP3 Jig Boring Machine.

A machine, Type OP3, with optical scales instead of precision leadscrews and having the same capacities as the type 3BA is also available.

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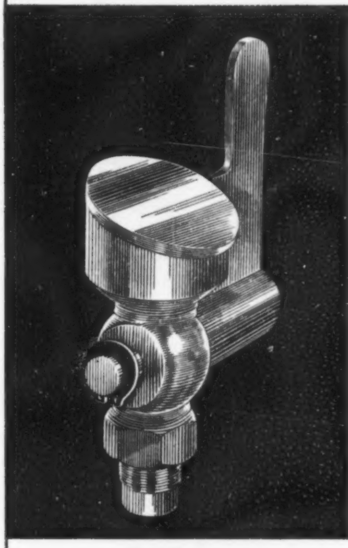
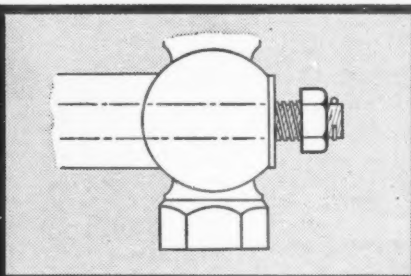
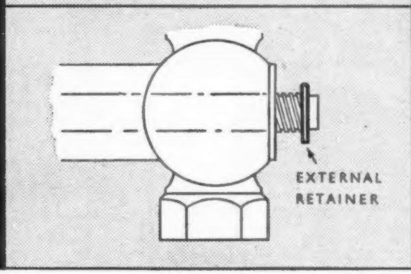




OLD WAY
To provide a shoulder for the tensioning spring on this filler cup entailed an extra long, threaded shaft, a nut, a hole drilled to take a cotter pin and an altogether tedious assembly.



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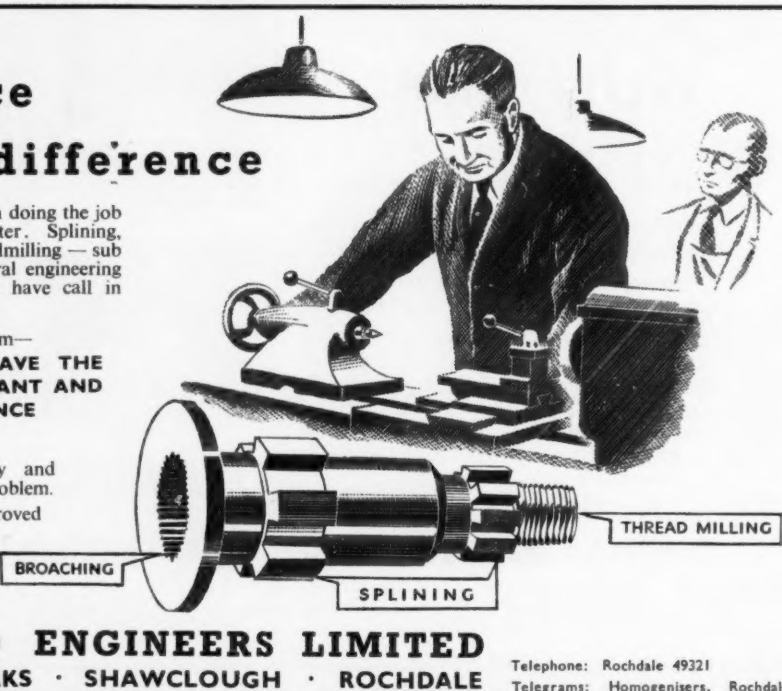

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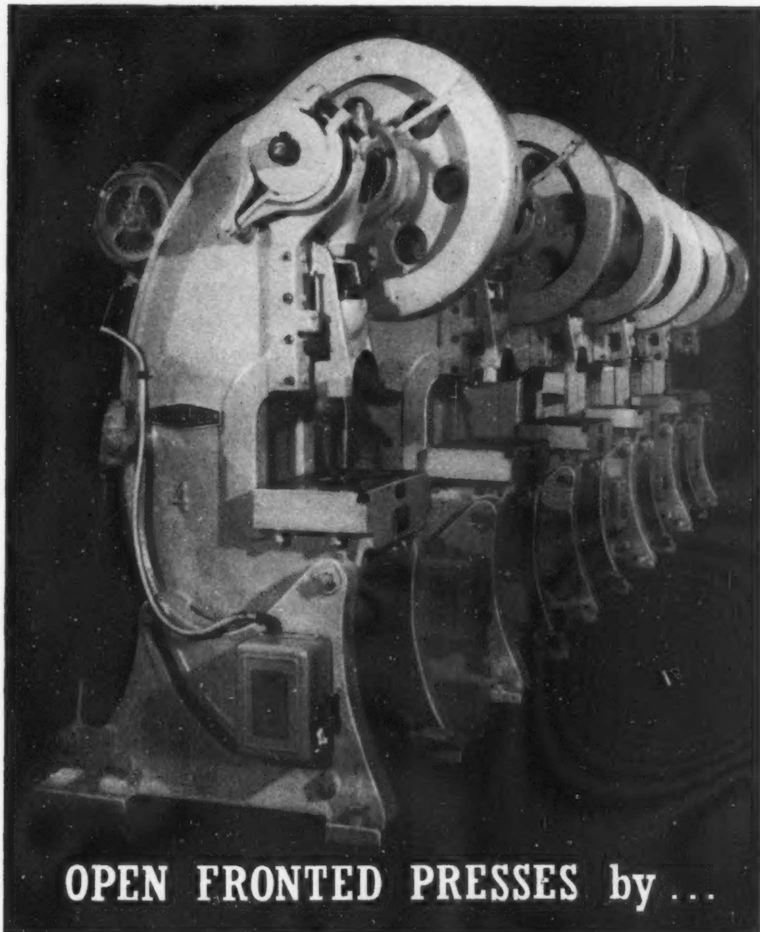
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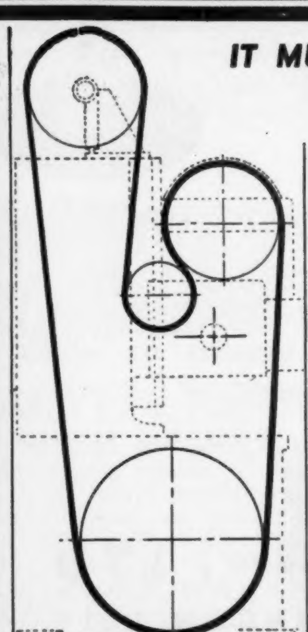

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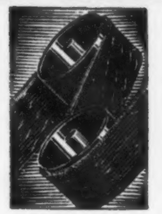

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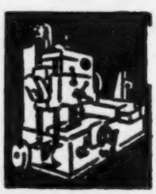

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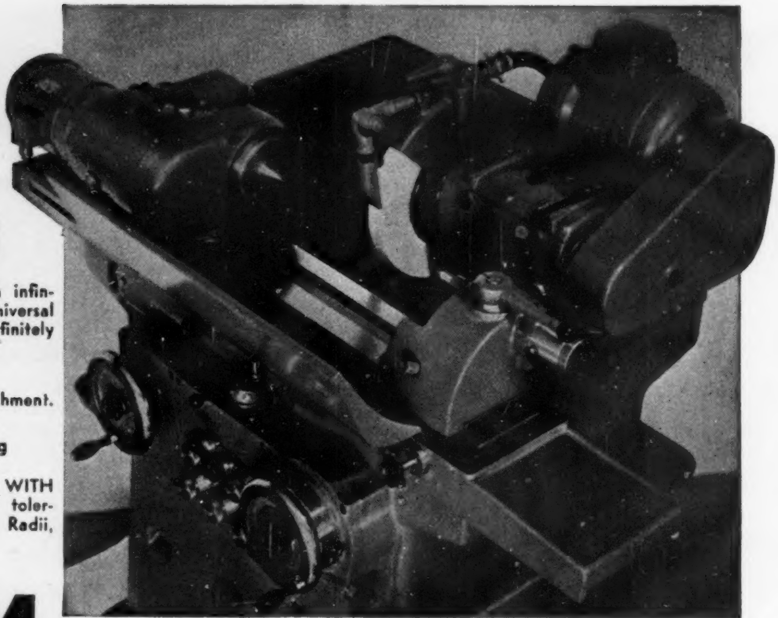

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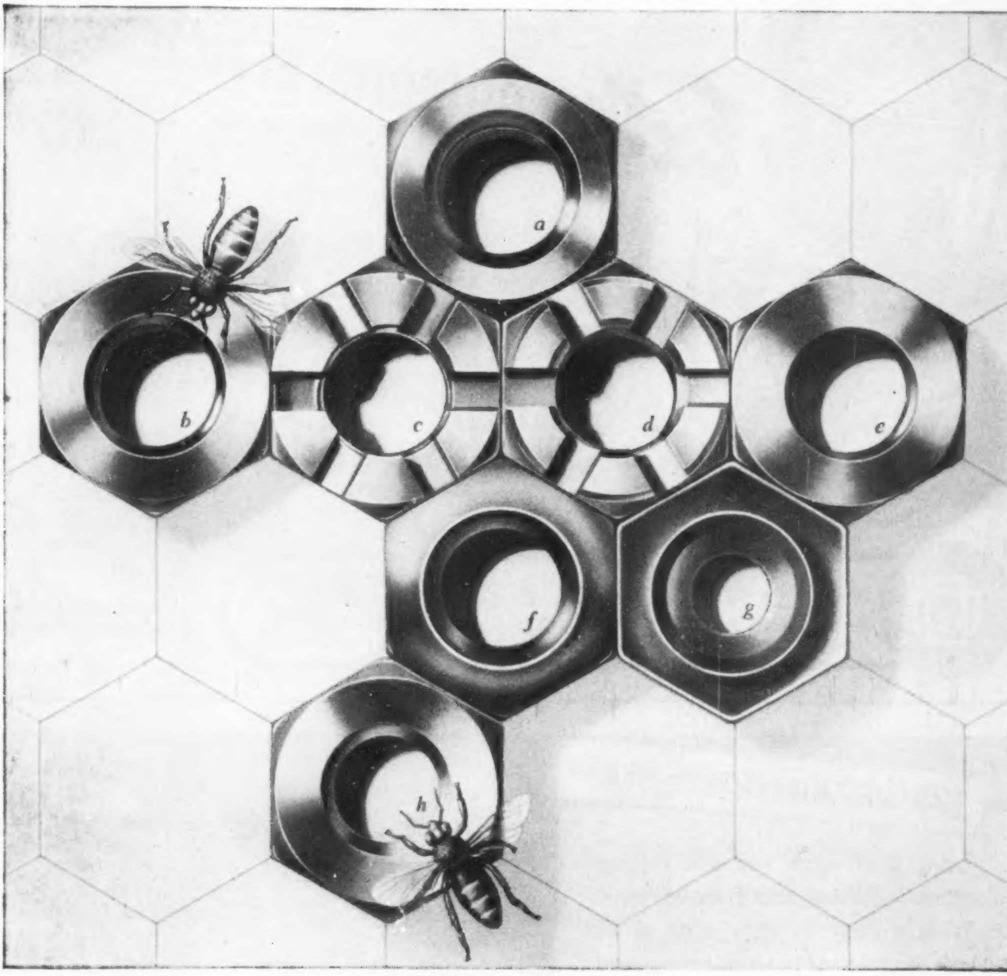

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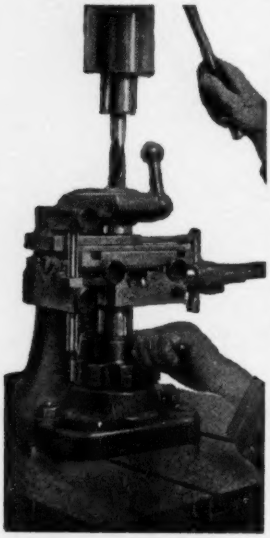

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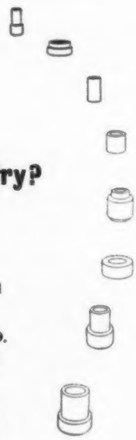

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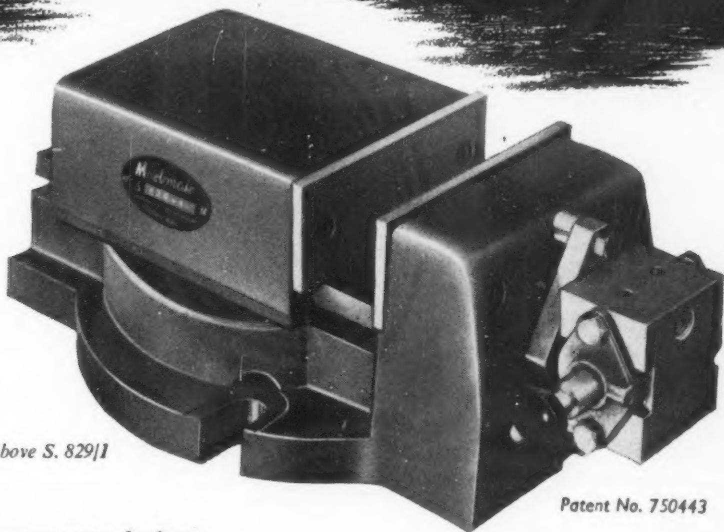

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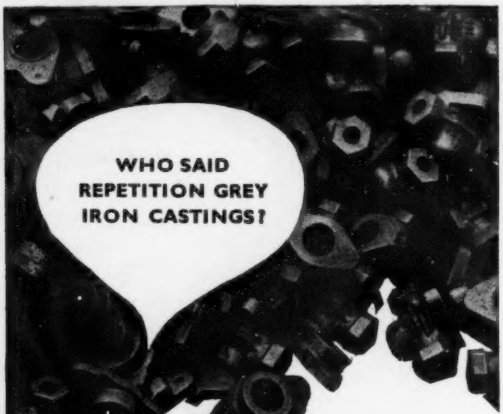

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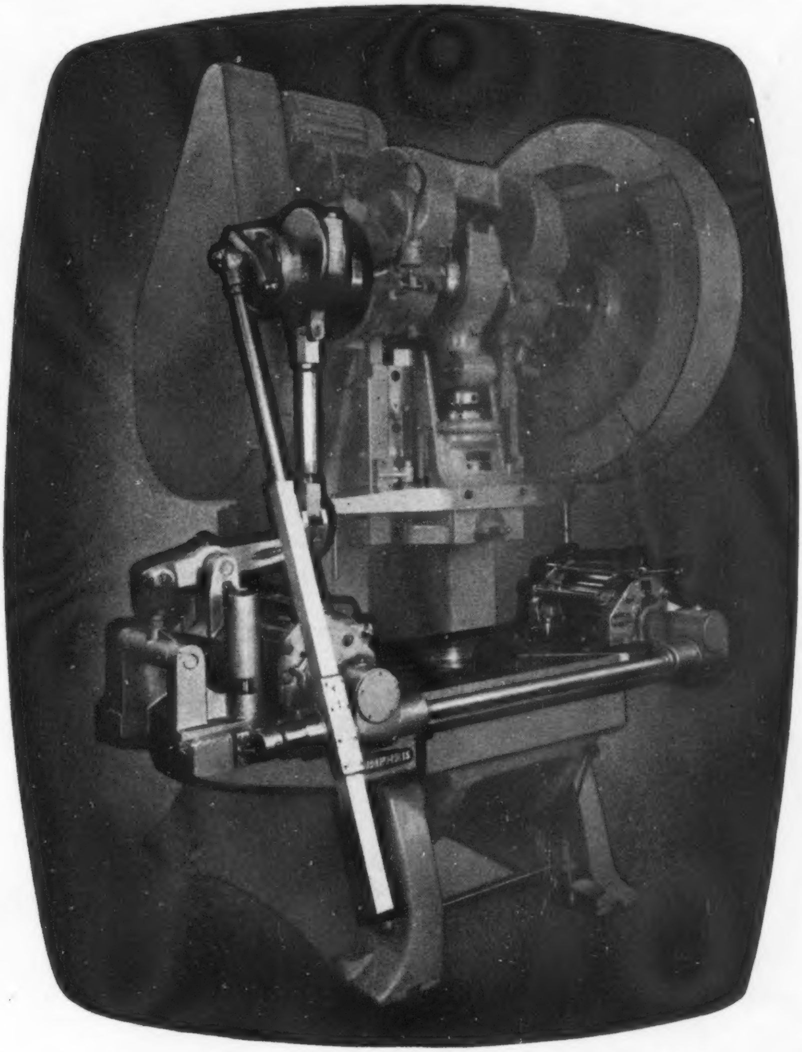

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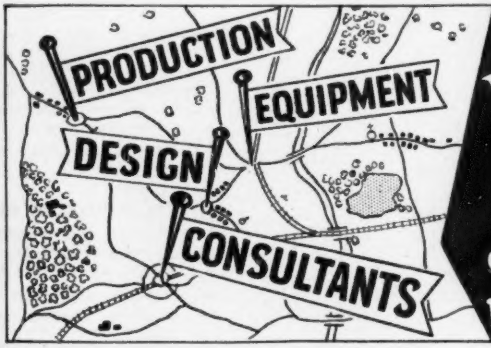

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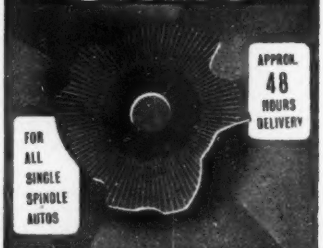

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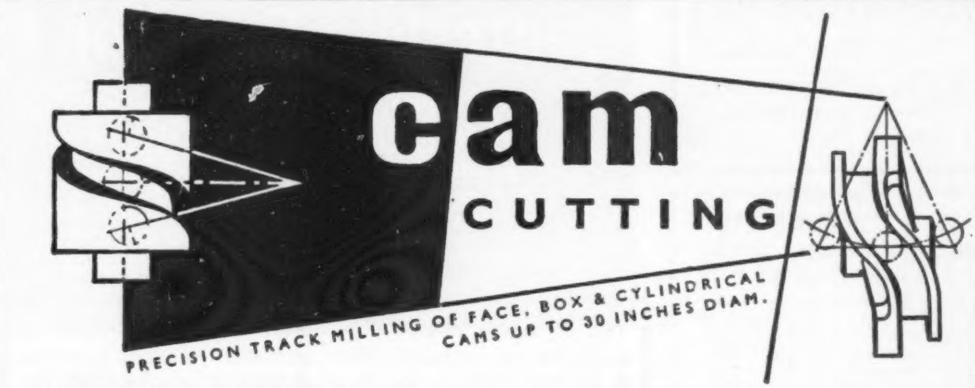

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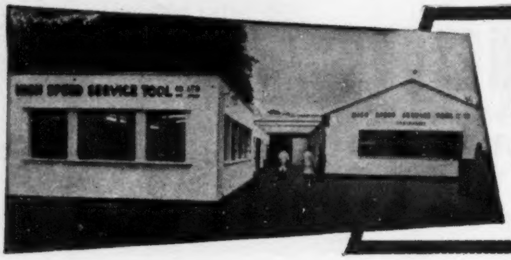

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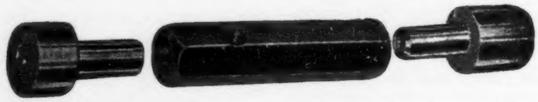

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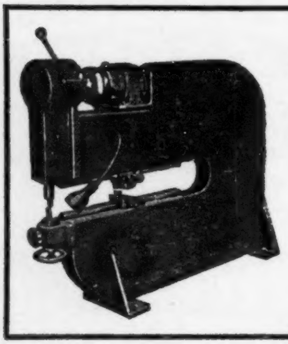

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The Proprietors of British Patent No. 723272, for "An Improved Machine Comprising a Movable Grating, of the Dwight-Lloyd Type," desire to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder.—Further particulars may be obtained from MARKS & CLERK, 57 and 58, Lincolns Inn Fields, London, W.C.2.

The Proprietor of British Patent No. 603622, for "Improvements in and Relating to Transmission Cables," desires to enter into negotiations with a firm or firms for the sale of the patent, or for the grant of licences thereunder.—Further particulars may be obtained from MARKS & CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.2.

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BRADFORD 8in. S.S. & S.C.
RYDERMATIC No. 12 Multi Tool.
CARDIFF 7in. × 60in.
DENHAM 5½in. S.S. & S.C.
LEBLOND 11in. × 16in. Prod.
SOAG-OXFORD 6½in. × 24in. S.S. & S.C.
SOUTH BEND 9in. (Workshop). 14in.
10in. GLASS 7ft. 6in. b.c. S.S. & S.C.
LEBLOND Regal 10in. swing.

MILLERS (Horizontal)
U.S. (Whitney Type) Production.
VICTORIA M2. Table 40 × 10.
KEMPSMITH No. 1G and 2G.
BROWN & SHARPE No. 12 and 000 prod.
CINCINNATI 08 & 1-18 Prod.
BROWN & SHARPE No. 2 Univ. Light.
CENTEC No. 2. Table 12in. × 3⅝in.
SUNDSTRAND No. 00 Rigidmill.
BURKE. Table 16 × 3½.
ARCHDALE 28in. Mfr. and G.P.
CINCINNATI 3-24 Hyd. & 2 M.H.
HERBERT 1S. Table 18in. by 8½in.

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RICHMOND VHM. Table 26 × 8.
VICTORIA V2. Table 40 × 10.
ARCHDALE 30in. Table 48 × 12½.
HERBERT 15S. Table 50 × 10½.

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BESCO TVO Bench, 4 ton.
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TURNER RH14/12.

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HULLER No. 2 5/16in. Cap.
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FACKS Plain, cap. 3in. × ⅝in.
REINECKER 8 × 72in.
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HANSON WHITNEY. 8in. × 40in.

Pfauter R2. Max. dia. 39in., D.P. 2½. Hobbing face spurs 11½. Six hob speeds.—BOX Z394, MACHINERY, Clifton House, Euston Road, N.W.1.

Sykes Vertical Gear Generator V.10.—BOX Z391, MACHINERY, Clifton House, Euston Road, N.W.1.

D. S. & G. Lathe, S.S. & S.C. Type 4AN. Capacity 7in. by 42in. A.G.H. Gap Bed. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

Colchester Mascot (New), 8½in. height by 54in. between centres S.S. & S.C Gap Bed Centre Lathe. Motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Willson 7½in. A.G.H. Gap Bed Centre Lathe, 3ft. 6in. b.c., 25½in. swing in gap. M/D 400/3/50.—ALBERT EDWARDS (MACHINERY), LTD. 79/89, Pentonville Road, London, N.1. 'Phone: Terminus 0167/8/9.

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NEW UNUSED 500-TON UPSTROKE HYDRAULIC PRESS

Table 200in. by 100in., Stroke 40in. Approach Speed, 240in. per minute, Pressing Speed 36in. per minute, two auxiliary and three main Rams, complete with all Pumps, Hydraulic and Electrical Controls. Favourable Terms. Details :

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Telephone: ELGar 4841-4842.

Archdale 28in. Horizontal Miller with vertical milling attachment, 400/3/50.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

Saws. 6in. × 6in, Power Hacksaw (new), £55. Grob Bandsaw with brazing, £85.—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

Classified Advertisements (*PLANT FOR SALE, contd.*)

Dean, Smith & Grace 7in. height × 4ft. 6in. between centres S.S. & S.C. Gap Bed Centre Lathe, motorised 400/3/50. —SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

AIR CYLINDERS, 2in. bore, 2in. stroke, fitted with built-in double-acting solenoid valve, 24 volts D.C., precision made to A.I.D. standard Price 19s. 6d. each. Plus Postage 2s. 6d.

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1½ h.p. VARIABLE SPEED MOTORS, 440 volts, 3 ph, 870-1,370 r.p.m. Price £12 10s.

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New **SUN VIC** Controls, Type F103/4, 220/230 volts, 3,500 watts. Price £2 10s. each.

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Knight No. 20 Vertical Milling and Semi-Jig Boring Machine, table 33½in. × 9in., motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Drills. Richmond SR2 36in. Radial (new). Pacera MB4 ⅜in. Bench Drill (new). Progress No. 1 ½in. Bench Drill (new). Denbigh 1¼in. Pillar Drill (nearly new). Kitchen & Wade E26 4ft. Radial (new).—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

Taylor & Challen No. 1220 press, inclinable, 3in. stroke, 2in. adj. to stroke, 20 tons cap. Fully guarded, good condition.—C. L. THOMAS, LTD., 18, Park Avenue, Solihull 1281.

Norton Plain Cylindrical Grinder. Type C. Capacity 6in. × 18in. Plunge feed. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

Workpans, Large Quantities Strong Gauge Workpans, size 16in. by 14in. by 5½in., forged riveted handles, approx. weight 8 lb., price 8s. 6d. each, quantities. Other sizes manufactured.—Contact J. BURTONS WORKS, Astley, Shrewsbury. Tel. Shawbury 266

Woodhouse & Mitchell (New) Turret Milling Machine, table 36in. by 9in., power feed table, slotting head, coolant pump and lighting. Motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Barber & Colman No. 8 Hob Grinder.—BOX Z393, MACHINERY, Clifton House, Euston Road, N.W.1.

12in. Cushman Combination Universal Chuck, 4-jaw, self-centring and independent with adjustable and reversable jaws. New. £45.—BOX Z409, MACHINERY, Clifton House, Euston Road, N.W.1.

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Namco Self-opening Diehead Type D.B.S. $\frac{9}{16}$in. capacity, as new, complete with grinding fixture and micrometer gauge, ½in. B.S.P. chasers, £40—cost double.—"EUCO," 44, London Road, Kingston, Surrey.

CHURCHILL-REDMAN 7NM S.S. & S.C. Gap Bed Lathe. All-Geared, 400-440 volts, 3 phase, 50. 2⅛in. H.S. Q.C.G.B. Admits 2ft. 3in. b.c., 26in. dia. swing in gap.

GLASS 9½in. by 10ft. 6in. S.S. & S.C. Gap Bed Lathe. All-Geared, 220-380 volts, 3 phase, 50. 2$\frac{5}{16}$in. H.S. Q.C.G.B. Admits 6ft. 6in. b.c. 30in. dia. swing in gap.

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NORMAN E. POTTS (B'HAM) LTD.
offer:—

MURAD ⅝in. cap. Capstan Lathe. Motorised.

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ARCHDALE 4ft. Radial Drill. 3 Independent Motor Drive, No. 4 M.T. Mtd., 400/3/50.

PRATT & WHITNEY 2-spindle No. 1B Rifling Machine.

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Telephone: Central 2287. Telegrams: Acfirb. Cent. London

AVAILABLE FROM STOCK

All machines listed below are at our Works in Sutherland Walk, Walworth Road, S.E.17.

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HERBERT Auto. Junior.
HERBERT 3A Chucking Auto.
INDEX OR 12 Auto.
ACME-GRIDLEY, Type R, 4-spindle, ⅞in. capacity.
ACME-GRIDLEY, Type R, 4-spindle, 1⅝in. capacity. (2 machines.)
WICKMAN 4mm. Swiss Type.
RYDERMATIC No. 12 Multi Tool Lathes.

BORERS.

New GRAFFENSTADEN AF.075 Horizontal Borer, 3in. dia. travelling spindle, 17⅜in. dia. faceplate.

GRINDERS.

ABWOOD Vertical Spindle Surface.
BROWN & SHARPE No. 2 Surface Grinder.
JONES & SHIPMAN Fig. 62M Plain Cyl. 8in. dia. by 10in.
LANDIS 10in. by 18in. Plain Grinder.
CHURCHILL 24in. by 10in. Universal.
BRYANT 16C 16in. Internal Grinder.

CAPSTAN LATHES.

HERBERT No. 0 ½in. collet cap. (2).
MURAD ⅝in. Capstan Lathe.
SOUTHWARK No. 2 1½in. Capstan Lathe.
DRUMMOND Type K Capstan Lathes (2).
GISHOLT No. 4 Friction Head Capstan.
LIBBY 4R 2in. Capstan Lathe. Bar feed.
BARDONS & OLIVER No. 5 Capstan Lathe.
HERBERT No. 7 Turret Lathe.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES.

SOAG OXFORD 6½in. Centre Lathe.
SOUTHBEND 13in. swing taper turning.
WILLSON 8½in. A.G.H. Lathe.
CARDIFF 8½in. by 48in. Lathe.

MILLERS.

HERBERT No. 1 Horizontal.
VICTORIA MO Plane
New VICTORIA U1 and U2 Universal.
ARCHDALE 20in. Horizontal Mills (3).
ARCHDALE 28in. Horizontal Mill.
OLIVETTI FP2 Manufacturing Miller. Table 52⅜in. by 14½in. Longitudinal traverse 39⅜in.
RICHMOND VHM Vertical Mill.
New VICTORIA V2 Vertical.
HOLROYD T117 Thread Miller.
HELLER Automatic Thread Millers (4).

MISCELLANEOUS.

JONES & SHIPMAN 2-spindle Pillar Drill, with No. 3 M.T. spindle, power feed.
New ESSEX 18 Bandsaw.
New RICHMOND SR2 3ft. Radial Drill.

All Machines motorised 400/3/50 unless otherwise stated.

Horizontal Boring. Dickinson 3in. Travelling spindle Horizontal Borer, No. 5 M.T., 45in. × 28in. Main Table, 10 h.p. motor for 400 volts, 3 phase, 50 cycles A.C. supply, £595.—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

Progress 5E (New) 2in. Capacity Pillar Drilling Machine with compound table, motorised 400/3/50.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

Classified Advertisements (*PLANT FOR SALE, contd.*)

Denbigh C4 Horizontal Semi- Universal Milling Machine, table 46in. by 10in. Motorised 400/3/50. Three machines available, one with Richmond High Speed Milling Head.—SOUTHERN ENGINEERING & MACHINERY CO., Connaught Buildings, Tanners Brook, Millbrook, Southampton. Tel.: Southampton 73101.

P 7R Swiss Automatic Machine, first class condition, available in approximately two months. 400-440 volts, 3 phase, 50 cycles A.C. Offers.—Apply MECHANISM LTD., 6a, George Street, Croydon, Surrey.

Hydraulic Surface Grinding Machine, J & S Model 540 No. 1154-52. Little used, completely overhauled, excellent condition, original paint. £495 or best offer for quick sale.—HARBOT'S, Devonshire Road, Leicester.

Factory Vacuum Cleaning Instal- lation Plant, consisting of 8-stage Sturtevant Pump and 6 h.p. motor mounted on C.I. bed plate. Approx. 300ft. aluminium tubing with pick-off points for mounting over benches. Dust collecting bin and large box of fittings for fitting out a works. Price £250.—BOX Z404, MACHINERY, Clifton House, Euston Road, N.W.1.

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6 Brookes 5 Speed Motors, S.C. 1½ h.p., 400/3/50 current. R.p.m. 250 to 3,000. With British Thompson-Houston change pole switches. Type D. Also available: Reduction Gears, 1,040 to 1, suitable for these motors.—BOX Z412, MACHINERY, Clifton House, Euston Road, N.W.1.

Edwards 6ft. × ¼in. Undercrank Guillotine. Rushworth 8ft. × ⅛ overcrank Guillotine.—S.P.P. CO., Admiral Works, Walmer Road, Pakefield, Lowestoft (Tel.: Pakefield 110).

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Betts Slotter. 12in. Stroke, wartime, 29½in. dia. table, hand/auto feeds all ways. 400/3/50. £750.—A. MCNAMARA & CO., New Line, Bacup, Lancs. Phone: Bacup 946.

COMBINED PLATE BENDING & STRAIGHTENING ROLLS

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Capacity 20ft. by 1in.
in unused condition.

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600

VARIABLE SPEED DRIVES—400-440/3/50.

H.P.	*MAKER*	*TYPE*	*SPEED RANGE*
270	B.T.H.	Schrage	370/95
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170/27.5	B.T.H.	Schrage	1,000/400
0/150	Mather & Platt	Ward Leonard	0/520
0/33/33	Mawdsley	Ward Leonard	0/1,000/ 1,450

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Large stock of single action and double action Presses for all duties.

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"John Hands" No. 8 Panel friction screw press, 120 capacity. Table 4ft. × 4ft., for large sheet metal pressings. Motor drive and safety guard.—H. JENNINGS & SON, Cardigan Street, Birmingham 4. 'Phone: AST. Cross 1891.

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ATTRACTIVE PRICES

IMMEDIATE DELIVERY.

ULRO—Urquhart Lindsay & Robertson Orchar—12ft. × 5ft. × 5ft. Double Column Planing Machine, with 2 tool heads on cross rail and 2 side heads, built 1946. All electric A.C./D.C. Lancashire Dynamo drive, cutting speeds up to 120 f.p.m. In excellent condition.
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BUTLER 8in. Slotter, High Production, table dia. 20in., admits in dia. 24in. H.P. Motor 5.
ORMEROD 8in. Slotter, table dia. 18in., admits in dia. 30in., h.p. motor 4.
All Slotters have automatic and hand, long./cross and rotary table movements.

Offered as purchased or fully rebuilt.

Inspection invited.

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14in. **BUTLER** Slotting Machine. 39in. diameter table. 9-40 strokes per minute.

24in. × 9in. **BUYSER** High-speed Vertical Milling Machine. Spindle speeds 265-1,860 r.p.m. As new.

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SHEpherd's Bush 4401.

Classified Advertisements (*PLANT FOR SALE, contd.*)

Vertimax Model H Production Lathe, 15in. max. swing 12in. turning dia., 9in. turning length, battery of 4 machines for disposal. Almost new.—BOX Z437, MACHINERY, Clifton House, Euston Road, N.W.1.

Shapers. Invicta 6MR 24in. Shaper (nearly new), £425.—TATE MACHINE TOOL CO., LTD., 6, North End Parade (opp. Olympia), London, W.14. Telephone: Fulham 6563 (3 lines).

AUCTION

By Order of R. M. RUSBRIDGE, Esq.
GROVE COTTAGE,
NEWDIGATE, SURREY.

CUBITT & WEST
are instructed to Sell by Auction
on **WEDNESDAY, 8th OCTOBER, 1958,**
at ELEVEN A.M. PUNCTUALLY

The Important Sale of MACHINE TOOLS AND EQUIPMENT
including
1948 WARD 2A and
1955 WARD 3A CAPSTANS
1957 WILSON MK5 CENTRE LATHE
DRILLING MACHINES, HACKSAWS, GRINDERS, WELDING EQUIPMENT and VALUABLE SMALL TOOLS AND MEASURING EQUIPMENT.
Also BUILDERS' AND BLACKSMITHS' EQUIPMENT

View Day: Monday, the 6th October (10.30 a.m. to 4 p.m.).

Catalogues, price 6d., may be obtained from Messrs. CUBITT & WEST, Surveyors & Valuers, London Road, Dorking, Surrey. (Tel.: Dorking 2212/3).

On the instructions of **W. CAVANAGH, Esq.,** A.C.A., the Receiver for the Debenture Holder re **GEO. C. RUTHERFORD LTD.,** Jacquard Makers, Blackburn,

G. F. SINGLETON & CO.
will offer for SALE BY AUCTION, piecemeal, on **WEDNESDAY, 1st OCTOBER, 1958,** at 11 a.m. prompt (subject to conditions of sale), at GREAVES STREET WORKS, off Montague Street, BLACKBURN, Lancs., the Motorised

MACHINE TOOLS

CENTRE LATHES: "Mitchell" 8½in. (new 1953), "Woodhouse & Mitchell" Junior 70 (new 1952), "Kerry's" model C, 5in. × 23in. (new 1954).
DRILLING MACHINES: One 4ft. Radial, "Herbert" 4-spindle, "Bradson" Pillar, 20in. swing Pillar, 13in. swing Pillar, and "Ajax" Bench.
"P & M" 6in. Capstan Lathe, "Parkinson" No. 2T Milling, "B & S" No. 2 Slotting and "Atherton" Grinding Machines, Electric Hand Grinders, Tapping Heads, Screwing Tackle, Drills, Reamers, Micrometers, Milling Cutters, End Mills, Chain Blocks.

WOODWORKING MACHINES.
Pedestal Saw Bench, 26in. × 16in., "Oliver" 6in. Planing and Jointing.

JACQUARD CARD MACHINES.
"Hardacre" Vincenti Fine Pitch 1320's and "Wadsworth" 400s Piano Card Cutters, "Devoge" Peg and Lace Hole.

Also 5 Electric Motors, 10/1½ h.p. Harness Assembly Frames, Linen Thread, Jacquard Sundries and Works and Office Furnishings and Equipment, "Dexion" Racking and Vices.

The Lots will be on view on 29th and 30th September, 1958, from 10 a.m. to 4 p.m., or by appointment.

Catalogues from the offices of the Auctioneers, 9 Richmond Terrace, Blackburn (T.N. 7722/3), 53, King Street, Manchester 2 (Dea. 7954/7), or the Receiver, W. Cavanagh, Esq., A.C.A., Messrs. WATERWORTH, RUDD & HA E Central Buildings, Richmond Terrace, Blackburn (T.N. 4128).

By Order of the DIRECTORS of Messrs. PLANLOC ENGINEERING LTD., following disposal of the Property.

Messrs.
FULLER HORSEY
Sons & Cassell
have been instructed to offer for SALE by AUCTION in Lots on the Premises, TUDOR WORKS, CHERTSEY ROAD, BYFLEET, SURREY, on TUESDAY, 7th October, 1958 at eleven a.m. precisely.

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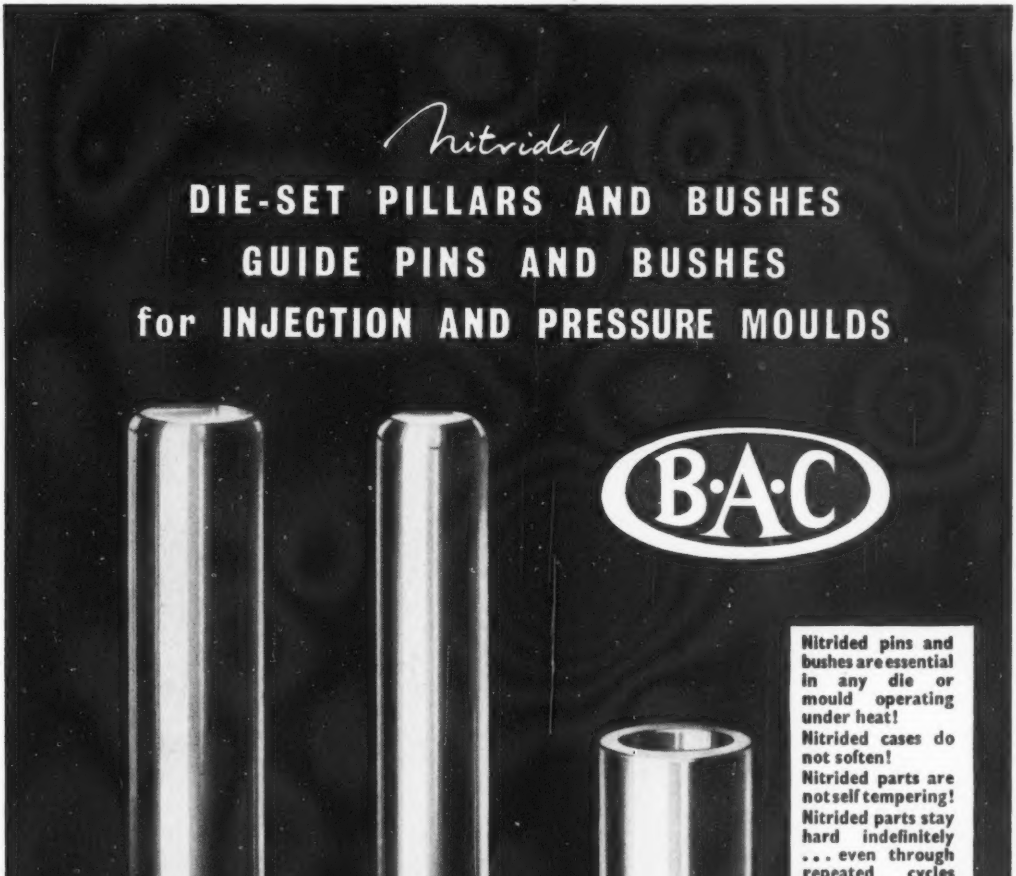

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